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REVIVING AN ASPHYXIATED MINER.—[See page 200.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progres· in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

Our Decadent Merchant Marine

THERE was a period during the middle of the last century when the merchant marine of the United States led the world. For many decades past, it has seen a steady decline. To-day it is threatened with absolute extinction. Our shipping register for foreign trade now amounts to only 782,517 gross tons, the smallest amount, if we except the year 1898, during the past seventy years. Subtract from this tonnage vessels which have outlived their usefulness, vessels in the trade between Atlantic and Pacific coast ports, by way of the Isthmus of Tehuantepec, which, although cargoes can be carried only by American ships, are required to be registered, and subtract also tonnage on the Yukon River, and but little is left outside of the steamers built for the ocean mail of 1891, and the five trans-Pacific liners which fly the American flag. Last year, American ships carried only 8.7 per cent of our exports and imports, the smallest percentage, if we except the year 1901, in our history.

It is to Congress that the country must look for the first movement in setting right these altogether impossible conditions; and the most workable method for starting the great work of reconstruction would be an extension of the ocean mail act of 1891. The bill now before the Senate provides that American ocean mail steamships of 16-knot speed or upward, and of 5,000 gross tons or over, shall be paid by the Postmaster-General for carrying the ocean mails, $4.00 a mile on routes to South America, south of the Equator, payments to be made for the outward voyage only. The bill prohibits the award of contracts to any bidders engaged in competitive transportation, or engaged in the importing or exporting business. Contractors must not give any preference or advantage to any particular person, company, firm, corporation or locality, or to any particular description of traffic. Contracts are to be awarded to those bidders who offer the highest seagoing speed.

Now, the causes of the present deplorable condition of our once famous fleet of ships engaged in the foreign trade are simple, easily understood, and impossible of contradiction. In the first place, ton for ton, a ship of a given size can be built more cheaply in foreign yards than in our own. The ship, when once afloat, sets sail upon her life of useful service with a perpetual handicap upon her profit-earning capacity, represented by the interest on her higher first cost. The difference in cost between American-built and foreign-built merchant ships is not so great to-day, it is true, as once it was. The remarkably low price at which ship plates and other structural steel material are produced in our mills, coupled with the development of large shipbuilding establishments provided with the most up-to-date plant, has served to bring the cost of construction much nearer the European figure; but the fact remains that the average to-day is somewhat higher in this country. If, under the fostering care of the Government, exercised through suitable mail subsidy legislation, our merchant marine should begin to grow in numbers and tonnage, there would be an increase in the number of ship yards and an increasing flow of orders to those that already exist. The ultimate result of this increased activity would be a somewhat lower cost of production.

The principal cause of the present stagnation is to be found in the much greater cost of running American ships, as compared with ships sailing under foreign flags. Existing laws for the protection of American seamen, and for their general comfort, demand that they shall be housed, fed, and generally cared for on a scale whose cost is far greater than that obtaining on foreign ships. The pay, both of officers and men, is higher, and it is a fact that, even if we could build always as cheaply as the foreign shipyards, the extra cost of running the ships would be sufficient, on many steamship routes, to practically wipe out any profits.

In view of these conditions, it can be said that to all intents and purposes, the construction of foreign-going merchant shipping is an infant industry which will require in the early years of its development the same federal recognition and support which has enabled the United States during the past quarter of a century, to found, develop, and bring to a lusty growth and vigorous manhood, many industries, which to-day are among the most extensive and successful in the country.

We note that in his last report the Commissioner of Navigation urges the necessity of giving federal aid to such American shipping as will make use of the Panama Canal, whose formal opening will take place on January 1, 1915, some four years hence. Unless it is proposed at the outset, he says, to abandon entirely to foreign shipping, ocean communication between the United States and the west coast of South America, by way of the Panama Canal, legislation to secure the establishment of American mail lines through the Canal should be undertaken at once. It is pointed out that there is ample precedent for the payment from the Treasury of the United States of tolls which will accrue on vessels of the United States passing through the Panama Canal. It is sufficient to refer to the fact that as a means of stimulating the development of national shipping, Russia, Austria-Hungary and Sweden refund Suez Canal tolls to such ships as use the canal. Indirectly, through their subsidies to national mail lines using the canal, such a refund is, in effect, the policy of Germany, France, Holland, Japan, Italy and Spain. It is significant, moreover, that the British and Oriental steamship company subsidy of $1,600,000 happens to be almost exactly the sum of the Suez Canal tolls.

If we remember rightly, the United States is paying out annually between 300 and 400 millions of dollars to foreign steamship companies for carrying its foreign commerce. Government assistance amounting to but a very small fraction of this sum, would ultimately put us in a position to carry this trade ourselves. The Government is expending nearly 400 millions of dollars in opening up via Panama shorter sea routes to the South American coasts. The remittance of Canal dues to American built and manned ships would go far to secure the bulk of this trade for American shipping.

The Importance of a Wood Collection in the National Museum

PUBLIC attention should be directed toward the urgent need of a collection of North American woods in the National Museum at Washington. The lumber industry of the United States stands fourth in value of its product. Yet there is no place in the United States where a complete collection of North American woods is exhibited except in the American Museum of Natural History, New York city. Timber merchants and wood users recognize the need of men technically trained for identifying woods. Such work can only be carried on in connection with a complete collection of authentic wood specimens. The demand for authoritative information regarding commercial woods is continually increasing.

Most large colleges and universities are provided with means for giving practical instruction in assaying. Ores and precious stones are in museum collections for observation, study, and experiments. Every opportunity is afforded the student to become familiar with the subject in all its phases. It is vastly different when one looks for the same opportunities in that study of woods which is technically known as "xylology." Institutions of learning have collections of mosses and algæ obtained through considerable expense; they have microscopic slides of desmids and diatoms which have no interest to the average layman and only to comparatively few systematists. The economic value of the groups of plants represented by these objects is very small compared to the product of the forest, and yet the latter has received very little recognition in systematic museum work.

There are numerous purposes, each one of which in itself would be amply sufficient to justify a collection of authentic wood samples in the National Museum. The chief purposes are to instruct the public and to furnish material for the investigator. In the main, the collection should consist of a reference collection and exhibition material.

A collection of woods should not alone be a storehouse of facts, but it is important that provision should be made from the start for a laboratory. The aim of a reference collection is two-fold, the one striving toward a knowledge of the structure of wood and the other toward the diffusion of that knowledge. The former consists in investigating and discovering new facts, while the latter tends toward educating the people and applying the discovered facts to the advantage of all. Aside from the need of this collection there should be a museum collection similar to the one in the American Museum of Natural History, New York city. No pains should be spared to secure similar material for exhibition purposes in Washington. In addition to the exhibition samples and enlarged micro-photographs of transverse and longitudinal sections, it will be necessary to show specimens of leaves from the trees and a map giving the range of growth and information as to the uses of the wood.

Not only should every effort be made to obtain representative specimens of native woods, but the plans and buildings should be large enough to hold woods from other countries. It has been estimated that the collection of a complete set of North American wood samples alone would require a million dollars' endowment. Whatever the expenditure, it would be an unusually good investment of national funds. The buildings and contents of the South Kensington Museum in London cost Great Britain about five million dollars, and competent authorities estimate that an auction on the premises would bring not less than one hundred million dollars. If suitable quarters are provided there is no doubt that a donation in the form of specimens and money, worth many times the original outlay, will be received. Large importers of foreign high-class cabinet woods will be anxious to exhibit samples of their choice woods. Not a few people are attracted by a collection of woods as much as by one of agricultural products. Undoubtedly a wood collection appeals to the public, and where this is the case much that is valuable will soon find its way to the museum. Foresters with zeal and ability will doubtless collect and donate samples of wood from all parts of the world. All that is required is to prepare the place and the proper publicity will guarantee the material in due time. Invaluable material can be readily obtained through consulates. Other museums having material in storage would doubtless loan or donate a considerable share of it to the national collection. Every country in South America would be glad to exhibit in the capital of the United States representative samples of the product of their forests. There can be no doubt that a national institution such as this would attract men of learning, for it would open an entirely new line of work from which the industrial and scientific world could draw invaluable information. Foreseeing the benefits which would result to science and industry by the successful establishment of a representative wood collection, it seems doubly imperative that immediate steps should be taken to carry these suggestions into effect.

Refined Measurements

THE extreme delicacy of scientific measurement is shown by an apparatus of English invention for comparing official standards of length. Its action depends upon the interference of light-waves, causing shadow bands, the width of which is half the wave-length of the light employed. The red radiation from hydrogen or cadmium is used, and its wave-length is, say, the fifty thousandth of an inch. The machine carries two microscopes, one of which is attached to one of the glass plates reflecting the light and producing the interference bands. First the recognized standard rod—say the imperial standard yard—is placed under the two microscopes, and one of its terminal marks is brought under the spider-lines of each. Then the rod to be tested is substituted, and one of its terminals is accurately adjusted. If it varies from the length of the standard, the other microscope, carrying the reflector, must be shifted until coincidence is obtained. The number of bands that move past during the shifting, multiplied by the half-wave-lengths of the light, gives the difference in length of the rods.

Professor Gisbert Kapp

A Distinguished Electrical Engineer

By P. F. Mottelay

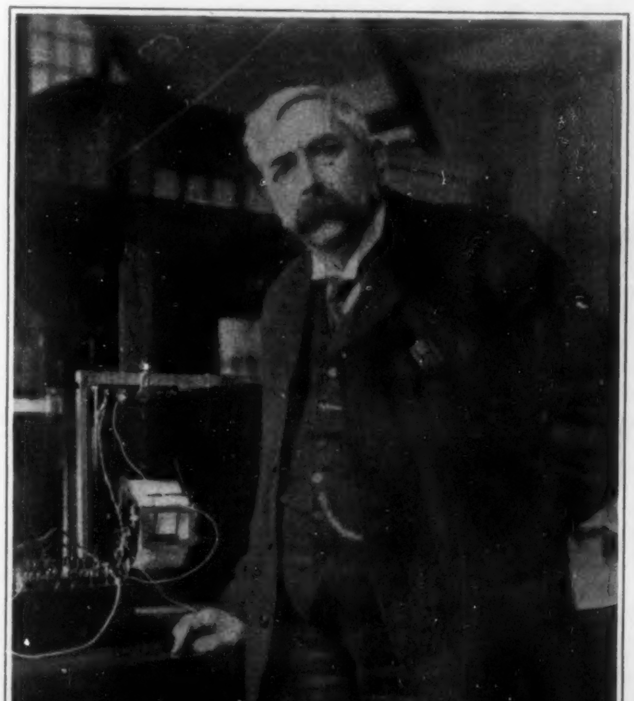
PROF. GISBERT KAPP, at the present time occupying the chair of electrical engineering at the University of Birmingham, England, is a man of broad training and wide and varied experience. By birth he is, on his father's side, of German extraction; his mother was Scotch, and in later life he himself became a naturalized British subject. He was born at Mauer, near Vienna, Austria, in 1852. He received his first scientific training at the Polytechnicum at Zurich, which he entered in 1869, and where he studied under Gustav Zeuner and the celebrated Wilhelm Kohlrausch. He received from this institution his diploma in mechanical engineering, and proceeded thence to the Arsenal at Pola, where he spent twelve months and gained valuable experience in marine engine work.

At the age of twenty-two he left his native country and took up his abode in London, where he occupied the position of chief draughtsman in the well-known establishment of Gwynne & Co., hydraulic and gas engineers. He remained in the employ of this firm for five years, during which he had frequent opportunities of visiting different places on the Continent, notably in Holland, in connection with the installation of steam pumping and other plants. He subsequently became the technical representative of Messrs. Hornsby & Sons, Limited, a large firm of agricultural implement manufacturers, located at Grantham, England. In the employ of this firm also his duties took him on extensive travels, covering practically the whole of Europe, and extending as far as Cyprus, Algiers, and even Egypt. He thus made a study of the conditions under which agriculture was carried on in widely different localities, and rendered signal services to his firm by ascertaining the various points and features in which they were in a position to benefit foreign consumers through the introduction of their improved steam and other implements.

On his return from one of these trips he visited the great Paris electric exposition of 1881, and was so much attracted by what he saw there, and by the field which appeared to be opened for new industrial developments, that he decided to enter this branch of work, which seemed to offer greater and more profitable scope than the enterprises with which he had been until that time identified. He accordingly left the employ of Messrs. Hornsby & Sons, and devoting himself earnestly to the study of electrical engineering, entered the firm of Crompton & Co., being appointed manager of their works at Chelmsford. He found here every opportunity that he could have desired for the technical research for which his mind was eminently fitted, and, in collaboration with Mr. Crompton, worked out a number of improvements, notably in dynamo design, which were ultimately made the subject of a series of patents. In 1885 he resigned his position with Messrs. Crompton & Co., and established himself as consulting engineer in Westminster. Among the inventions made by him up to this period may be mentioned the introduction of compound winding for dynamos, and a class of electrical measuring instruments, wherein permanency of calibration is obtained by the use of over-saturated electromagnets. These inventions were worked out in conjunction with Mr. Crompton, and were protected by joint patents. Subsequently, Dr. Kapp received independent patents for his special method of making dynamos self regulating without using two circuits on the field magnet; for a self-regulating arc-light dynamo; for an alternating current dynamo; for a high-speed steam engine to be used in conjunction with continuous current dynamos; for a system of alternating current distribution insuring constant pressure over an extended district; for boosting the return feeders on electric railways; and for an alternating current generator. The technical exploitation of his inventions has been largely in the hands of W. H. Allen & Co., of Lambeth; Johnson & Phillips, of Charlton; Lawrence Scott & Co., of Norwich; F. M. Newton, of Taunton, and others.

Dr. Kapp continued in his practice as consulting engineer until the year 1894, when he was offered and accepted the general secretaryship of the German Society of Electrical Engineers. During his tenure of this office, he functioned as editor of the *Elektrotechnische Zeitschrift*, the organ of the society named. He had previously had experience in editorial work in connection with the journal then issued under the name *Industries*, but now known as *Industries and Iron*.

At this stage in life, Dr. Kapp enjoyed a growing popularity, and his patents and consulting practice were proving very remunerative. He was continually being retained by various German municipalities and firms engaged in the handling of the traffic of the country. The calls which he received in his professional capacity took him to all parts of Europe, and his advice in the construction of electrical tramways was sought in Norway, Italy, and Russia, while in consultation on questions of municipal distribution of electricity, he was called among other places to Zurich, Lucerne, and Winterthur. In these capacities he had added fully ten years to his valuable experience, when he was called, in December, 1904, to fill the newly created chair of electrical engineering at the University of Birmingham, England. Under his able management, the laboratories of this institution, located at Bourn Brook, near Birmingham, have developed into one of the best equipped centers of instruction in this branch of work within the United Kingdom.



PROF. GISBERT KAPP

Prof. Kapp is the author of many books, the most important of which are: "The Transmission of Energy and Its Transformation, Sub-division and Distribution" (fourth edition, 1894), "Alternating Currents of Electricity," "Dynamo Construction, Electrical and Mechanical," "Dynamos, Alternators and Transformers," "Transformers for Single and Multiphase Currents," "Electrical Engineering," "The Electrification of Railways" (being the lectures he delivered before the Royal Institution in 1908), "Electrical Engineering Designs" (taken from modern practice). Many of these were translated into French, Italian, Russian and German.

He has read a large number of papers before various societies. His first contribution, presented in 1885, before the Institution of Civil Engineers, and entitled "Modern Dynamos and Their Engines," earned him the Telford premium and medal. This paper was followed up during 1886 by another on "The Predetermination of the Characteristics of a Dynamo," read before the Society of Telegraph Engineers. His paper on "Alternate Current Transformers" appeared in 1888, and that on "Alternating Current Machinery" during the early part of 1889. His three Cantor lectures on "Electric Transformation of Power" were given before the Society of Arts in the spring of 1891, and he has also lectured at Chatham School of Military Engineering on "Electric Tramways and Alternating Currents." It should be mentioned that, while in Berlin, he held an appointment as lecturer on electrical engineering in the Technical University of Charlottenburg.

Prof. Kapp holds the degree of Doctor of Engineering *honoris causa* in two German universities. He has been president of the Birmingham University Engineering Society, was for two years chairman of the Birmingham Section of the London Institution of Electrical Engineers, on the council of which institution he served three times, from 1891 to 1893, afterward acting as vice-president during the years 1907-1909, and becoming its president for the period 1909-1910. He is, besides, a member of the English Institute of Civil Engineers, and an honorary member of the Physical Society of Frankfort.

The accompanying illustration, which is prepared from a photograph taken expressly for these pages, shows Dr. Kapp in the junior students' laboratory of his department at the University of Birmingham. In his face we read a combination of firmness and kindliness, which was no doubt largely instrumental in gaining him the success which he has attained. Since occupying the electrical engineering chair of Birmingham University, he has had the opportunity of showing to advantage his great merits as a teacher, of which no better testimony perhaps exists than the reported constantly increasing attendance at his lectures and classes. As an instructor, he happily personifies that rare combination, the ardent searcher and born expounder. In private, he always invites the *bonne camaraderie* that has won him so much of the open popularity he enjoyed on the Continent as well as in the different associations which he has been called upon to enter. He is considered very methodical, sympathetic, forceful, happily blending in his teachings the deliberation of the truly scientific thinker with an animation that carries conviction and gives evidence of his great interest in anything he undertakes.

The Project to Make Paris a Seaport

THE project of enlarging the bed of the Seine so as to bring sea-going vessels to Paris is now being agitated, and Municipal Councilor Denis voices the general opinion that the scheme is entirely practical and is what Paris needs above all for its future prosperity. All the traffic which it loses because Antwerp and Rotterdam are nearer the interior center of Basle than is the Havre seaport would then be gained. The $25,000,000 which is annually paid for the transport of freight from Paris to London in order to be reshipped will be partly economized. Besides, the metallurgical and industrial eastern region will have direct connection with England, and there will be no fear that a canal from Basle to Lausanne on Lake Geneva will take all the Swiss and Italian traffic away from France. Another point is that the $34,000,000 for work claimed to be indispensable for preventing future inundations of the Seine will not be needed. All capital put into the "Paris-seaport" project will be revenue bearing.

IT is estimated that there are about 530,000,000,000 board feet of timber on the national forests. Though the aggregate is great, these figures show a low average per acre of under 4,000 board feet. The work of reforesting shows an encouraging progress. Over 9,000 acres of reforestation were sown during the year. Something like a half billion feet of timber were sold during the past year. The sales of timber on the national forests have been growing less since 1907.

New Things in Aeronautics

Height Recorder for Balloonists: Curtiss's New Flying Boat

Measuring Your Height in the Air

THE problem of determining the vertical motion of a balloon is a complex one, and does not admit of wholly satisfactory solution; but there are several approximate solutions that answer ordinary requirements. The simplest device consists in throwing from the balloon scraps of paper, which fall at a very slow rate through still air, and noting the movement of the balloon relatively thereto. This method is sometimes refined by using paper of different weights, each of which has a known rate of descent and is distinguished by a particular color. This process, of course, gives only the vertical movement of the balloon with respect to the surrounding air, which may itself have a rapid vertical component of motion. The same criticism applies to the various forms of vertical anemometer, certain of which are described in the following paragraphs:

Hypsometric determinations are quite commonly based upon the readings of a barometer or barograph, on the assumption that there is an exact relation between altitude and atmospheric pressure; but this assumption is fallacious, for the vertical gradient of pressure is, in reality, subject to rather wide fluctuations. Furthermore, both the barometer and the barograph are somewhat sluggish instruments, and hardly respond to changes of pressure quickly enough to be of much assistance in keeping the balloon at the proper elevation, though their indications are indispensable for other purposes. A more sensitive instrument, analogous to the barometer, is the statoscope. This is made in various forms. A common one consists of a small reservoir inclosed in a metal case like that of a watch, the interior of which communicates with the outer air by a rubber tube. Part of the wall of the reservoir constitutes a flexible diaphragm, of rubber or metal, and is connected by delicate wheelwork with a needle, moving around a dial on the face of the instrument. While the rubber tube is open to the air, the pressure on the opposite sides of the diaphragm is in equilibrium and the needle points at zero. In order to take a reading of the instrument the rubber tube is pinched, thus preventing the outside air from having access to the reservoir. If now the outside pressure is reduced, corresponding to an increase of altitude, the air inside the instrument presses the diaphragm outward, while if the outer pressure is increased, the diaphragm is pressed inward, and these movements are communicated to the needle. The instrument is, in effect, a highly sensitive differential barometer.

An improved form of the statoscope is shown in Fig. 1. Here the diaphragm and the needle are replaced by a liquid column, which rises or falls in response to differences in pressure between the inner and outer air.

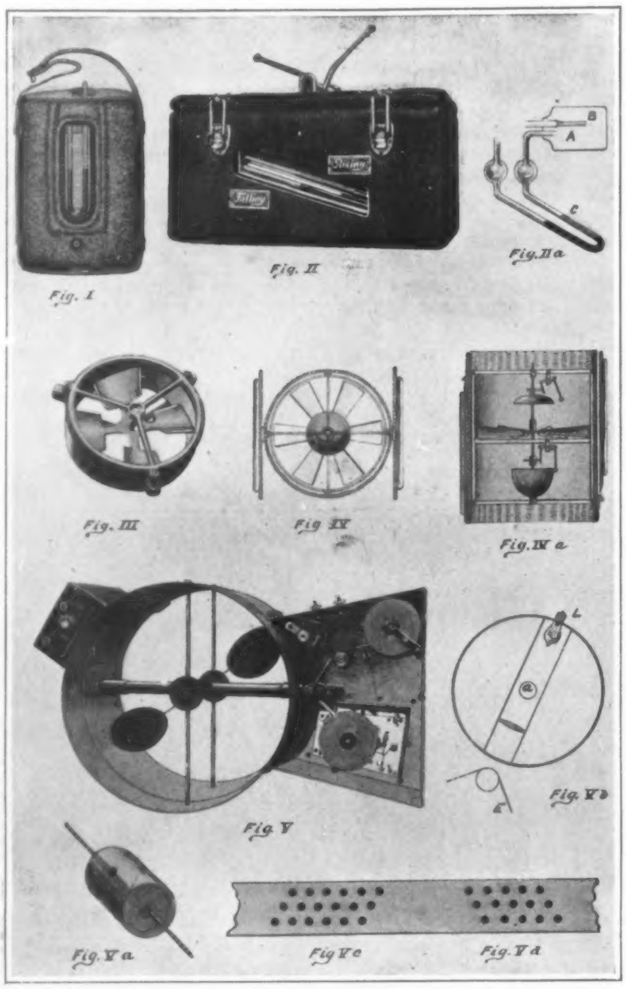
A further modification of this instrument is represented in a device recently introduced by A. Bestelmeyer,* called the pressure-variometer (Fig. 2). While the statoscope merely shows, at a given moment, the total rise or fall of the balloon since the beginning of an observation, the variometer indicates the *rate* of rise or fall. This instrument requires no adjustment before reading. The reservoir, *A*, is a Dewar flask, communicating with the outside air by means of a capillary tube, *B*, and also connected with a manometer tube, *C*. When the pressure of the outside air diminishes, air passes out of the reservoir at *B*, but owing to the small bore of the tube the change in the pressure of the air inside the reservoir lags behind that of the external air by an amount that is proportional to the rate of pressure-change. The liquid in the manometer-tube which is appropriately graduated, records this rate directly, in terms of vertical movement of the balloon. When the balloon is stationary in altitude, the instrument reads zero; when it is rising or falling at a constant rate, the liquid, having once adjusted itself to the correct reading, remains stationary. A velocity as small as 10 centimeters per second can easily be read.

Besides instruments that depend upon fluctuations in atmospheric pressure, several forms of anemometer are used to determine the vertical motion of the balloon with respect to the surrounding air. If the barometric instruments show that the balloon is neither rising nor falling, then these anemometers indicate the vertical movement of the air itself. A combination of the barometric and anemometric methods gives the nearest possible approach to a determination of the absolute vertical movement of the balloon.

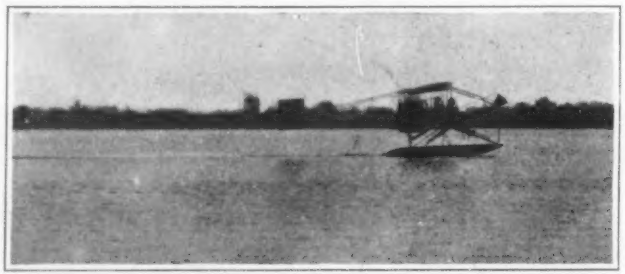
A simple form of vertical anemometer is shown in Fig. 3. This consists of a wind-wheel, mounted on a vertical axis. The direction in which the vanes of the wheel revolve shows whether the instrument is rising or falling with respect to the air; or, in case the instrument is stationary, whether the air itself has an upward or downward movement.

An ingenious modification of this instrument has been introduced by P. Lentz, of Gross-Lichterfelde, Germany, who calls his device the kodophone.* This is shown in Fig. 4. Here the axis of the wind-wheel is so adjusted as to ring one or the other of two bells, according to the direction in which the wheel is turning. These bells are of different tone, so that the aeronaut, who may be busy with other observations, does not need to examine the anemometer to determine whether the balloon is rising or falling. Moreover, he is instantly apprised of any change in the vertical direction of the balloon's motion, by the change in the sound emitted by the instrument. A further advantage offered by this instrument is that it is as useful by night as by day.

Another recent instrument, of a more pretentious character, is Ludewig's vertical anemometer,† as shown in Fig. 5. This instrument makes a continuous automatic record of the vertical movements of the balloon with respect to the air. Here the wind-wheel is very delicately mounted, within a protecting cylinder, *C*, so as to respond to the slightest vertical movement of the air. On the axis of this wheel there is a small hollow brass cylinder (Fig. 5 *a*), through which six holes are punched, each pair at opposite extremities of a diameter, two near the top, two near the middle, and two near the bottom of the cylinder. The diameters are inclined at 60 degrees to each other. This piece of apparatus is inclosed in a horizontal tube, *R*, at one end of which is an incandescent lamp, *L* (Fig. 5 *b*), and at the other a moving ribbon of sensitized paper. Whenever a pair of holes in the brass cylinder comes into line with the axis of the tube, the light from the lamp passes through, and is focused by a lens so as to make an impression upon the photographic paper. The latter is moved at a constant speed by clockwork. The character of the resulting record (see Fig. 5 *c* and 5 *d*) depends upon the direction and speed of the rotation of the wind-wheel, which in turn is dependent upon the vertical motion of the apparatus with respect to the air. The faster the wheel turns the more crowded will be the vertical rows of spots on the paper. This record can be interpreted numerically by means of an appropriate calculation, the speed of the ribbon being known.



Instruments for measuring speeds of ascent and descent of balloons.



Skimming the surface at 40 miles an hour before rising.

Side view of aeroplane showing single pontoon.

Curtiss in flight after rising from the water.

Curtiss's Single Hydroplane Float for Aeroplanes

By John Fulton Greer

GLENN H. CURTISS added another page to the history of hydro-aeroplaning the morning of February 1st, at San Diego, California, when he flew from and alighted upon the surface of San Diego Bay, using

(Continued on page 211.)

* *Physikalische Zeitschrift*, 9, 1908, p. 862.

* *Cosmos*, 60, 1911. † *Physikalische Zeitschrift*, 11, 1910.

Labor Saving by Automobile Power

Gasoline vs. Perspiration

By Walter Langford

The power plant of an automobile does other useful work besides that of driving the vehicle. In this illustrated article the reader is told how very much cheaper and more efficient the motor is than the human arm for lifting and hauling. Tractor trucks, pulling one or more loaded vehicles, are increasingly employed. An 8-ton motor truck pulling two trailers and hauling an aggregate load of 25 tons is being employed in fortification work by the Austrian Army. A crane, operated by the motor of the tractor, facilitates loading and unloading, and a cable and drum outfit is employed to climb stiff grades.

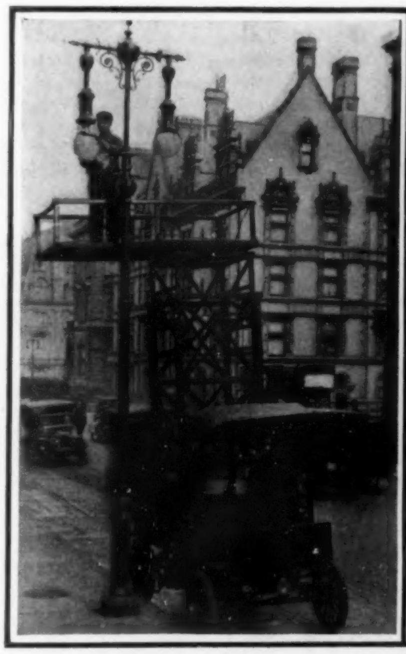
THE usefulness of the automobile as a time and labor-saving machine through its superior speed and carrying capacity as compared with horse-drawn vehicles is now being increased by arranging the regular power plant of the vehicle, or a separate power equipment carried on the vehicle, to perform special work, other than the propulsion of the vehicle. There are two general classes of these labor-saving automobiles, represented in the accompanying views of typical applications: Machines with an equipment designed to replace the human muscle of their drivers or crews in such operations as dumping coal delivered to steam-power plants and private residences, loading and unloading lumber and other materials, the operation of winches for various purposes, and pumping water, and to save time or labor by other special means; and machines in which the power equipment is utilized for mechanical purposes beyond the scope of human or animal labor, such as high-efficiency street sweeping, vacuum cleaning, threshing and other farming operations, and pipe thawing by electricity.

One of the best-established of these auxiliary applications of automobile power is the power-dumping coal cart. A firm of contractors having a city contract for hauling coal, ashes, gravel and other bulk materials, employs a steam truck, having a dumping body of large capacity hinged at about the middle of its length. This remarkable vehicle carries a load of 7 cubic yards of wet ashes, and makes ten to twelve one-mile trips per day, from a power house to a new street which is being filled in, as compared with half that load carried and half the number of trips per day by the ordinary horse-drawn truck. The coal merchant employing electric trucks has found it cheaper in labor expenses to tip out his loads of coal by a small motor under the seat, rather than to continue the old hand-crank method. A remarkable application of portable electric power is a pipe-thawing equipment consisting of a motor generator or transformer carried on the truck for delivering a large current at low voltage through the "frozen-up" pipes between curb side or hydrant and water faucet.

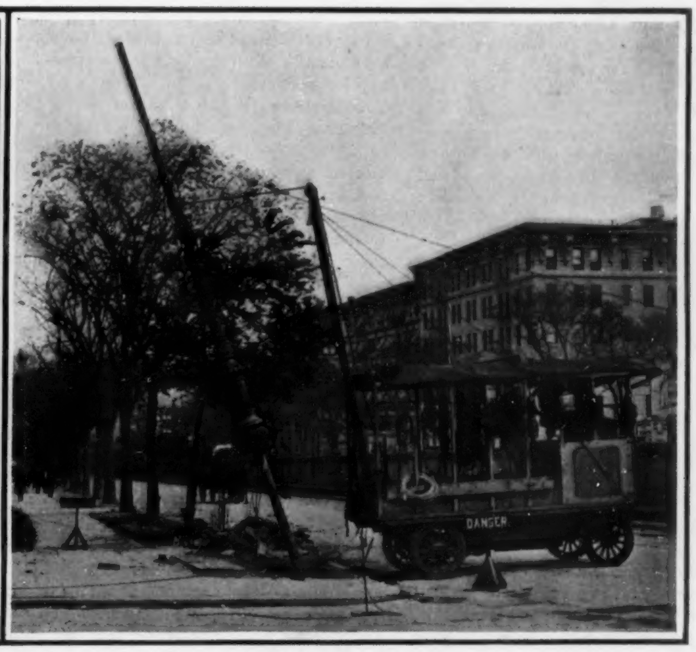
Pumping water out of electric subway manholes—frequently required after heavy rainstorms or on account of breaks in water-mains—is an operation that is being neatly handled by some of the more progressive electric-supply, telephone and telegraph companies by a power-pumping outfit carried on the "emergency wagons." The Boston Electric Co. has improved on the former method, of teaming to the flooded district a clumsy hand pump and two to four men to operate it, by placing a gasoline-driven rotary pump on one of its electric trucks. An electric light company of Providence, R. I., has provided an electric motor-driven pump with starting rheostat and connections, which can be placed on any of the trucks of the company and operated from its storage battery. Another electric outfit has a 225-ampere-hour battery in place of the usual 165-hour battery, and a double-pole switch, so that the pump cannot be thrown in while the vehicle is running, or *vice versa*.

The construction departments of the various electric service

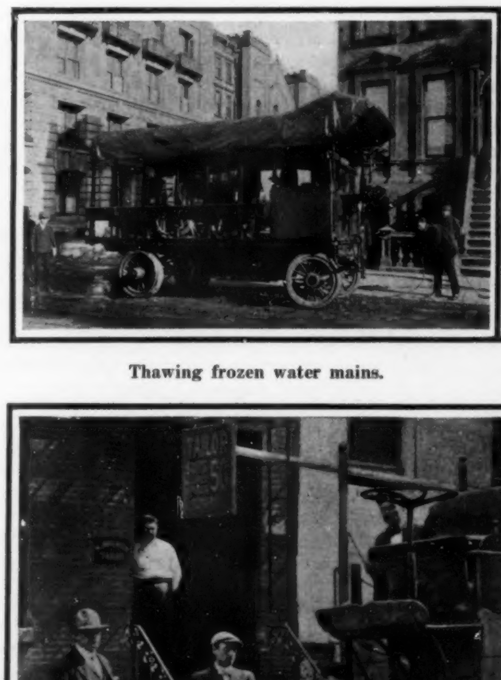
(Continued on page 211.)



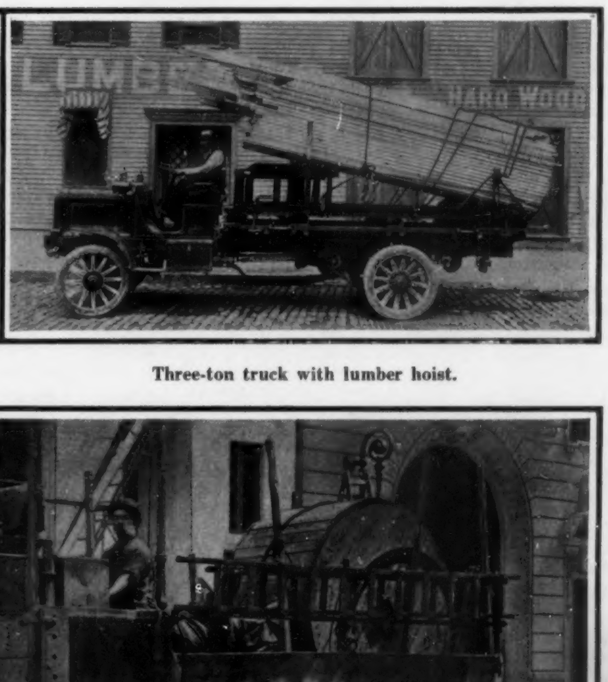
Trimming arc lamps from a tower wagon.



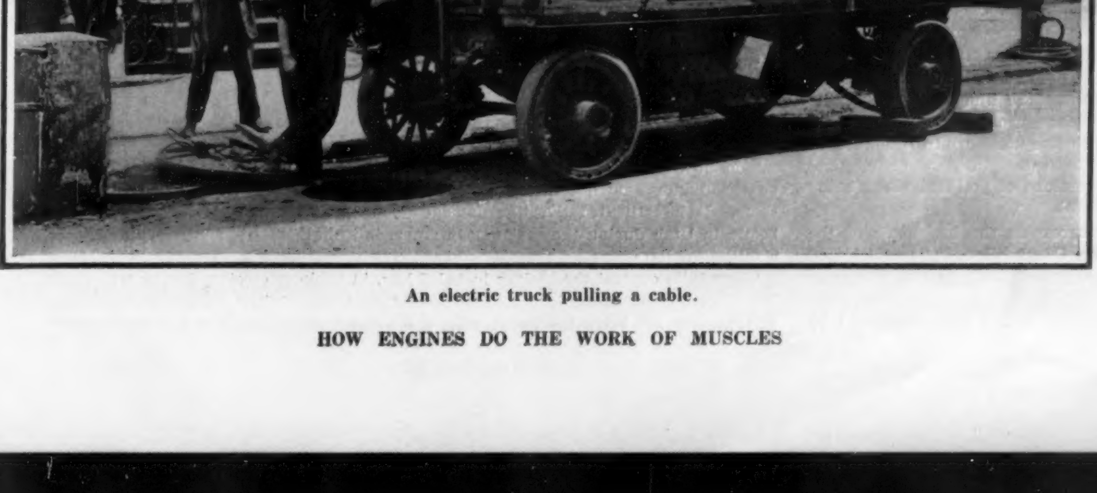
Setting a city arc lamp post.



Thawing frozen water mains.



Three-ton truck with lumber hoist.



An electric truck pulling a cable.

HOW ENGINES DO THE WORK OF MUSCLES

Observations Among the Workshops of Europe—I

Practical Hints for the Extension of Our Machinery Trade

By Capt. G. L. Carden, U. S. Revenue Cutter Service

[The value of the European market as an outlet for American trade has increased rapidly during the past few years. With a view to ascertaining conditions in the machinery trade, the United States government recently sent Capt. Carden to Europe, where he was given unusual facilities for inspecting the establishments, big and little, which are engaged in the manufacture of machinery. Capt. Carden finds that there are great opportunities open to American trade, particularly in the export of those machine tools in which we lead the world. The following articles will be found to contain much valuable information as to the conditions prevailing in Great Britain and on the Continent.—EDITOR.]

THE possibilities of the foreign market, especially in recent years, have not, it is safe to say, been fully appreciated by the majority of American machine tool builders. This is the natural outcome of the enormous demands at home. There has been little incentive to study over-sea conditions, and not only has the question of foreign business been underestimated generally, but the capabilities of foreign machine tool builders have not been fully perceived.

Generally speaking, the best grades of American machine tools excel both in design and workmanship the foreign built tools. There are a number of foreign shops, however, which are approaching very closely to American standards; but, as a rule, the great majority of the European machinery houses are far below American works in point of shop efficiency and cost of production. The Germans have fine shop organization, but lack sufficient territory to permit of specializing. Their country is too circumscribed to make it possible for a new firm to hope to live on the domestic trade. Export business is, therefore, the life of the nation, and the best thought and energy are directed to the interest of foreign commerce.

When one considers industrial Europe of to-day we are apt to think largely of Germany. The industries in that country are indeed extensive, but there are other sections in Europe in which enormous progress has been made in the past few years, and is still in the making. I refer especially to Northern Italy, Bohemia, Hungary, Poland and the districts in Russia lying more especially in and about St. Petersburg and Moscow. The Milan and Turin sections of Northern Italy are the centers of rapidly growing manufacturing districts. The superb climate, the available electric power from the Alps, the efficient railway connections and the shipping facilities at Genoa all serve to enhance the manufacturing advantages of Northern Italy. The North Italian machinist has no superior on the Continent, he is naturally apt and soon becomes an expert man. There is no finer work turned out in the world than is in evidence in some of the Italian machinery shops. Large exportations of German machine tools during the past two years have been made to Austria-Hungary. That statement alone will indicate the manufacturing activity there. It would seem as though the possibilities of Austria-Hungary are only commencing, and in Hungary particularly there is an enthusiasm manifested, such as one would rather expect to find in a new country and among a young community.

In France in 1908, during a period when many American shops were closed down, manufacturing demands were so great that the French found it necessary to call upon foreign firms to build many of their locomotives. The French locomotive shops are among the best in the world, but they were not equal to the extraordinary demands made for railway equipment during the year mentioned, and in that period French locomotives were built not only in Germany but in Bohemia and Italy. One order for thirty-five locomotives was secured by the American Locomotive Works.

In general lines of machinery the standards in Europe to-day are higher than in America. This statement applies particularly with reference to steam engines. Take for example the works of Carels Bros. of Ghent, Belgium. This firm builds engines varying from 400 to 5,000 horse-power, suitable especially for mills, electric power stations, and similar installations. It is the pride of this firm that it makes a specialty of engines required to run continuously, without a stop, for, say, three months. The Carels guarantee for their super-heated steam engines a consumption of only 8½ pounds per indicated horse-power for triple expansion engines. What the Carels are doing is equaled by other firms in Europe. Sulzer Bros. of Winterthur, Switzerland, and Franco Tosi of Legnago, Italy, are also building superb engines, and the finish and workmanship on Continental engines generally are extremely fine. There is little hope for competition with the European engine builder of to-day except with engines possessing more economical features and giving evidence of superior workmanship.

The essential difference between European and American shops lies largely in manufacturing methods. For the most part, European works are building diversified lines. The principal machine tool builders are confining their attention wholly to machine tools, but even these firms find it necessary to build diversified lines of machines. This is directly opposed to the best practice in the United States, where we find shops confining their attention almost exclusively to a few types of tools.

The strongest competitors in the United Kingdom to-day of American machine tool builders are such firms as Herbert of Coventry, Darling & Sellers of Keighley, Kendall & Gent of Manchester, Richards of Broadheath and Lang of Johnstone. Lang, for example, is confining his attention almost exclusively to lathes. This statement is true of Darling & Sellers. Herbert is manufacturing a number of types of machines. His reputation is largely founded on a very few designs of machines. The Darling & Sellers shops at Keighley are small in extent, but the workmanship on their lathes is not excelled in Europe. It is a fact that a Darling & Sellers lathe fetches £30 more than some of our standard American lathes of the same size. The Keighley firm, however, is content to limit its output to a comparatively small number of machines per year.

The greatest need abroad for the proper exploitation of American machine tools is expert operators. In one of the big electrical houses in Switzerland, where a superintendent had been taken on, having had American experience and who understood American machine tools, it was found possible to reduce the cost of machine work on a certain make of pulleys from 3 francs each to 60 centimes. This demonstration was effected through the use of an American turret lathe. Previously, the work had been performed by an ordinary lathe.

As a rule, however, there is little, if any, direct representation from American firms in Switzerland, and the statement was made that there is only an occasional American caller at the works. Generally speaking, the sale of American machine tools abroad has been left to foreign agencies. There is no better market in Europe to-day for American shop equipment than in Switzerland. Swiss engine work is not excelled in Europe.

To understand properly Swiss industrial conditions it must be understood that Switzerland produces no coal and no iron ore. For the manufacture of machinery raw material is brought in, for the most part, from Germany; the latter country also supplies the greater part of the coal which is used. It is also a fact that some of the Swiss firms are paying less for their coal than is charged in Germany, according to the statements made by reputable officials. The iron ore is, for the most part, brought up to Mannheim on barges and then is train-hauled into Switzerland. In the winter season when the water is too low to admit of river service, the cost of transportation often increases from 25 per cent to 30 per cent.

Zurich is the center of industrial Switzerland. Within a comparatively short radius are the great electrical houses of Oerlikon and Brown, Boveri & Co., the machinery works of Escher, Wyss & Co., the Swiss Machine Tool Works, Sulzer Bros. and the Swiss Locomotive and Machine Works.

While Switzerland is lacking in iron and coal, the country can boast of an enormous amount of water power. Handicapped as the Swiss are for want of iron ore, they are able to maintain their position in the outside world only through superior technical knowledge, and in this knowledge they have much to thank their engineering institutions.

I found that the majority of the workmen are paid less in Switzerland than in the Berlin territory, but better than in the Chemnitz shops of Germany. Shop conditions in Switzerland are in a somewhat unsettled condition; there appears to be a great deal of drifting on the part of the workmen, and I was informed, in the case of one shop, that the beginning of each month finds about 50 per cent new men. As a rule, however, the percentage is from 20 to 25.

(To be continued.)

The Pan-American Commercial Congress

DURING the week beginning February 13th, there was in session at Washington a very interesting congress known as the Pan American Commercial Congress. The place of meeting was the new building of the Pan American Union, which is a handsome structure of modified Spanish architecture and one of the capital city's show buildings. Director General John Barrett, who is the prime mover in this congress, succeeded in procuring a list of notable speakers, prominent among whom were President Taft, the Secretary of State, Senator Root, Representative Champ Clark, and many members of the Diplomatic Corps. The purpose of this congress was to consider informally the opportunities for extending trade conditions in the twenty Latin-American countries for the manufactured and natural products of the United States, and reciprocally the market in the United States for the products of Latin America. The discussions were illustrated with maps and other exhibits, and the proceedings were purely educational and informative, and controversial only as they involved exchanges of opinion as to practical business methods, expressions of political views being strictly tabooed.

The Commercial Congress is the harbinger of the opening of the Panama Canal, when it is anticipated that the entire trade aspect of that part of the globe will be charged.

A subject of importance which was considered by the congress was that of "Trade-Marks," which is just now attracting a good deal of attention owing to the fact that it was a topic of serious consideration at the Fourth International Conference of American States, which was held in Buenos Aires last summer.

A Menace to the Alfalfa Crop

IN 1904 the entomologists of the Utah Agricultural Experiment Station discovered a weevil in an alfalfa field near Salt Lake City, which had not been known in this country before that time. Since then this insect (*Phytonomus murinus*) has spread in all directions over a large territory and threatens to extend its ravages throughout the alfalfa country.

At a recent meeting of the Biological Society of Washington, Francis M. Webster, of the United States Department of Agriculture, gave an account of the life history of the beetle and of its methods of diffusion. The eggs are laid in the young stems of the alfalfa plants, and as soon as the grub hatches out it climbs to the growing tip and feeds on the tender leaves, preventing the growth of the plant. As the season advances, the adult beetles are found feeding on the plants, gnawing through the bark and killing them. It is estimated that the damage done by this beetle in Utah during the past season amounts to half a million dollars.

The adults conceal themselves in baled hay, in packing material and cases, in cracks of freight cars, etc., so that they are being carried rapidly in all directions by the regular channels of commerce. In addition to this the flying adults are readily carried about by the winds. No means have been found for fighting this new enemy of one of the most important of our crops. Frogs and toads seem to be the only natural enemies in this country, and these cannot be relied on to be of much assistance in the comparatively dry regions where the alfalfa is raised. The birds do not seem to relish them, and no insect enemies have been found. The larvæ of similar forms in the Eastern States have been successfully combated by means of certain fungi; but these do not seem to attack the larvæ of the lucerne weevil.

The seriousness of this new danger may be realized when it is considered that in several of the Western States the alfalfa crop means the farmers' chief or even sole source of cash. The cultivation of alfalfa has developed so rapidly that the government statisticians have been unable to determine its value from year to year with any degree of accuracy. For 1908 the value of this crop was estimated by the experts as being over $100,000,000.

Aerological Observations in Nebraska

THE Weather Bureau has undertaken a series of sounding-balloon ascents at Omaha, Neb., extending over the period February 7th to March 3rd, inclusive, during which time daily ascents will be made. The results will be published in the bulletin of the Mt. Weather Observatory.

Correspondence

"Volator" and "Volation" for "Aviator" and "Aviation"

To the Editor of the SCIENTIFIC AMERICAN:

By reference to the Standard Dictionary (Funk & Wagnalls), you will see that the Brooklyn Morning Journal (July 22nd, 1891, page 1, column 6) introduced the word "aviator" into the English language.

The same authority shows that "aviation" was coined by the SCIENTIFIC AMERICAN SUPPLEMENT, February 8th, 1890, page 11754.

Both these are good words, but they are used so often by newspaper reporters and head writers that readers beg for a change. These two journals, fruitful in supplying words, may do a service to humanity by suggesting synonyms, namely, "volator" for "aviator," and "volation" for "aviation." "Volation" and "volator" are etymologically correct, and are sanctioned by lexicographers. It would be a great relief to have something new. What do you say, gentlemen? Will you help? WELLS DRURY.

Berkeley, Cal.

[We regret that we cannot concur with our correspondent in his suggested use of "volator" and "volation" as synonyms for "aviator" and "aviation." There would be confusion with the word "volition" (Latin *volo*, to will).—EDITOR.]

Non-inflammable Gas for Dirigibles

To the Editor of the SCIENTIFIC AMERICAN:

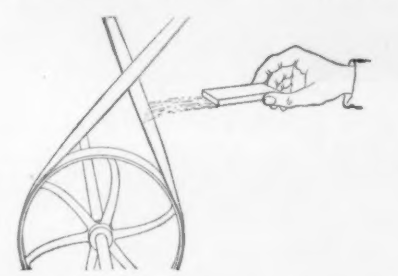
After reading a review of the accidents that have occurred during the past year to the birdmen and other aero navigators, it occurred to me that a suggestion from one interested in such matters might not be considered impertinent. I notice from time to time that some person or firm of wealth offers a prize, generally a sum of money, for some special achievement in science; as an example, the Nobel prizes. Would it be considered amiss for the SCIENTIFIC AMERICAN to suggest to the world at large that some party or parties interested in aeronautics offer a substantial prize (to be competed for by the chemists of the world) for a *non-explosive, non-inflammable* gas *lighter than air*. This might be accomplished by working on hydrogen, and combining it with another gas or gases, thus to a certain extent denaturing it, yet retaining sufficient of its buoyancy to make it practical for aeronautical purposes. I believe that the discovery of such a gas would be the assuring of the commercial uccess of the dirigible. True, the matter might prove a chimera, but I believe, if searched for in a systematic manner, it would be discovered.

Lolita, Tex C. S. MITCHELL.

A Phenomenon of Static Electricity

To the Editor of the SCIENTIFIC AMERICAN:

A peculiar effect happened in February, 1909, in the forge shop of the Louisville Manual Training High School. It was supposed to have been due to static electricity. A plate of hard steel about ½ by 2 by 6



inches was being ground at the emery wheel. As the belt was twisted, it was rubbing together about 18 inches above the wheel. One end of the piece was dipped into some oil at hand, to cool it, and was then being returned to the front of the wheel, wet at one end. It was held in the right hand. When the plate was distant about 10 inches from the belt, tiny streams of oil left the nearest edges of the plate, going toward the belt. They were deflected downward as a curve, possibly by the wind caused by the belt. The left hand interposed between the belt and plate caused the action to cease. This effect of the oil streams is not known to have occurred before this, but everyone knows that when one's hand is held a short distance from such a twisted belt, sparks leave the tips of the fingers, provided no one is touching the emery wheel or the rest. If the other hand is then held between the first and the belt, no sparks will leap across the air gap.

Lexington, Ky. HERBERT A. KOHNHORST.

Stereoscopic Effects of Solar Photographs

To the Editor of the SCIENTIFIC AMERICAN:

In examining the illustrations used by Mr. Wade with his article "What Are Sun Spots?" I was much interested in using the stereoscopic effect of the eyes on different pairs of the pictures, particularly of the six pictures to the left of the telescope picture on page 400, SCIENTIFIC AMERICAN, dated November 19th, 1910. I thought perhaps your readers might be interested viewing the craters in this way (or by mounting on cards and using a stereoscope). The light "clouds" seem to be floating near the craters, and the craters seem very deep.

Wichita, Kan. GUY H. WINN.

This letter was submitted to Mr. Frederick Slocum, of the Yerkes Observatory, who replies:

"There is nothing especially novel in the application of stereoscopy to solar photographs. We have frequently used the stereo-comparator here for that purpose. I do not recall that any stereo-pictures of the sun have been published. Very little scientific importance is placed upon the stereoscopic effects seen in photographs, for both Prof. Barnard and Max Wolf have shown that various effects can be produced by combining the pictures in different ways. In regard to the pictures in the SCIENTIFIC AMERICAN, the calcium clouds are, of course, floating above the spots. That is clearly shown in the picture taken at different levels on the right-hand side of your illustration on page 400; but whether they can be made to stand out stereoscopically, I am not so sure. Mr. Barnard, who as you know, has a remarkable power of stereoscopic vision, fails to get any perspective from the pictures as printed in your paper. I have tried some larger prints in a stereoscope, but get only fictitious perspective, due probably to a slight jarring of the telescope or to a slight irregularity in the running of the mechanism of the spectroheliograph."

Uncovering the "Maine"

IN a recent issue we gave an illustrated description of the plan adopted by the United States Army Engineers for uncovering the United States ship "Maine," so as to render it possible to make a careful examination of the condition of the wrecked portion of the hull and discover the actual cause which sent her to the bottom.

The disastrous explosion, whether it was due to the detonation of a mine placed beneath the ship, or to the spontaneous explosion of the contents of the forward magazine, or whether it was due to a combination of both, blew out the sides and deck of the ship, and, except for some connecting bottom plating, practically cut the vessel in two at about one-third of her length from the bow. The heavy bow, with its massive ram, sank first, bending downward so that the ram sank deeply into the mud. Then the after portion of the ship settled, leaving the vessel in 37 feet of water, with only the wreck of the superstructure and one mast standing exposed above the surface. The stern settled in the mud to a depth of 8 to 10 feet, the bow very much deeper.

Among the many plans submitted for recovering the vessel were several which contemplated lifting the wreck to the surface by means of heavy hydraulic gear and tackle. These were all rejected on the ground that the vessel was so badly broken up, that to lift it bodily would be to further twist and displace the wrecked portion of the ship, and so destroy its value as evidence in determining whether the explosion was from within or from without.

With a view to making an examination of the vessel *in situ*, the engineers have planned to build entirely around the wreck a huge watertight wall, pump out the water, leaving the bottom mud exposed, and then dredge away the mud from around the hull, leaving the latter entirely exposed for examination.

The cofferdam wall, which will be elliptical in shape, will consist of a series of fifty-foot steel piling, circular cylinders, the interlocking piling being driven down into the firm bottom some 70 feet below the surface. The joints between the several cofferdams will be made watertight by driving a segmental wall of the piling between each pair. As the cofferdams are completed, they will be filled in with clay, dredged from a bar lying adjacent to the wreck; and the weight of this clay will afford sufficient stability to prevent the cofferdams from being overturned by the external pressure of the water, when the inclosed space around the wreck has been pumped dry.

In order to further strengthen the cofferdam, it is planned to use rock from an old tunnel dump for backfilling along the interior face of the cofferdam at its base. When this has been done, the mud will be scraped away from the hull and drawn over toward the cofferdam wall, by means of drag buckets.

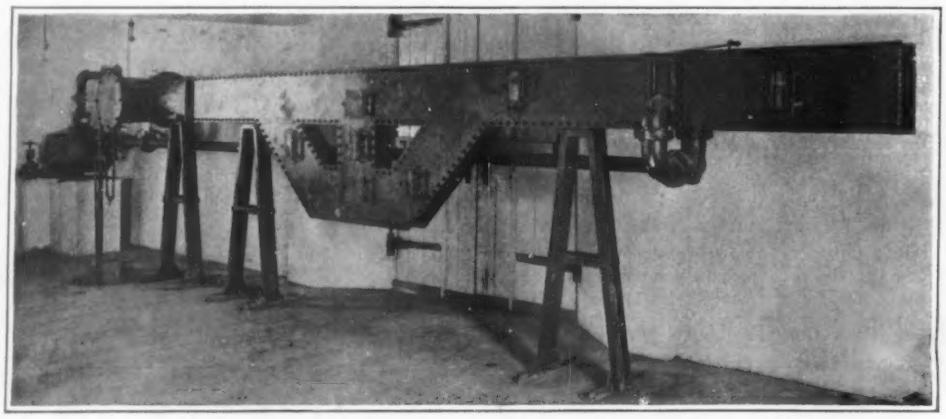
The work of driving the steel piling is rendered difficult by the fact that the bottom of Havana harbor is strewn with the accumulated wrecks and rubbish of many centuries. The scene of the salvage operation is one of great activity, as will be evident from a study of the accompanying photograph, which was recently taken in Havana harbor. In the center of the picture is seen the wreck of the ship. Beyond the main mast is seen a scow pile-driver engaged in driving one of the circular cofferdams, the wall of which is nearly completed. On the extreme right is a completed cofferdam, which shows clearly the character of the interlocking piling of which the wall is built. To the left is a partially completed cofferdam, and within it will be noticed the floating template, or form, which acts as a guide in putting down the piling. Congress has appropriated $300,000 for this work, and the preliminary estimate of the engineer corps is $275,000 for merely unwatering and exposing the hull.

In the center is the wreck. To the right is one of the circular, steel-pile cofferdams. To the left is a part of a cofferdam and a pile driver putting down steel piling.

GENERAL VIEW OF THE "MAINE" SALVAGE OPERATIONS

UNCLE SAM'S new Bureau of Mines is doing battle with many unseen and unknown dangers that lurk in the bowels of the earth to claim the lives of the men reaping the mineral harvests of this country, but none of its investigations are as important as its efforts to overcome the ignorance of these people concerning the dangers which encompass them in their daily toil. For much of the havoc among miners is due to lack of knowledge of the explosive powers of coal dust and fire-damp and to incompetence in selecting safe explosives for the blasts. Many of the miners seems to have no conception of the importance of a really safe "safety lamp," for often they purchase a dangerous substitute merely to save a few cents, thereby endangering not only their own life, but also that of hundreds of others. So Uncle Sam is establishing free schools to enlighten them. The school at Pittsburg, Pa., in the very heart of the coal regions, is the first of these new schools, but it is hoped that others will be opened shortly; one at Raton, N. M., for inhabitants of New Mexico, Colorado, and southern Utah, Wyoming and Nevada; another at Salt Lake City, for the central Utah fields and accessible to Montana and Washington, and a third near South McAlester, Okla., to take care of the coal miners of Oklahoma, Arkansas, southwestern Missouri and southeastern Kansas.

Sham mine explosions are created for the instruction of miners attending the school. The apparatus provided for this purpose is an explosive gallery—a great horizontal tube of boiler plate 100 feet long and wide enough for a man to walk through it without striking his head against the ceiling. Across the open end of this tube is placed a drumhead of heavy paper and the inside is then filled with fire-damp or coal dust which electric fans thoroughly mix with air until they are of the consistency in which they are ordinarily found in a mine. The drumhead keeps the gas or dusty air from escaping, and at the other end of the big tube is a twelve-foot cube of reinforced concrete holding a mortar aimed right down the tube and loaded with one of the explosives commonly used in mines. A wire connects this mortar with a key from which it is fired at a distance, and parallel with the big cylinder, but sixty feet away is the observation house. A long peep hole extends along the rear wall of this house, and a row of miners line up inside with their faces to it. Plate glass a half inch thick protects their eyes, and a shield outside the building is so directed that the vision of the men is directly on a line with the long cylinder stretched along the ground.



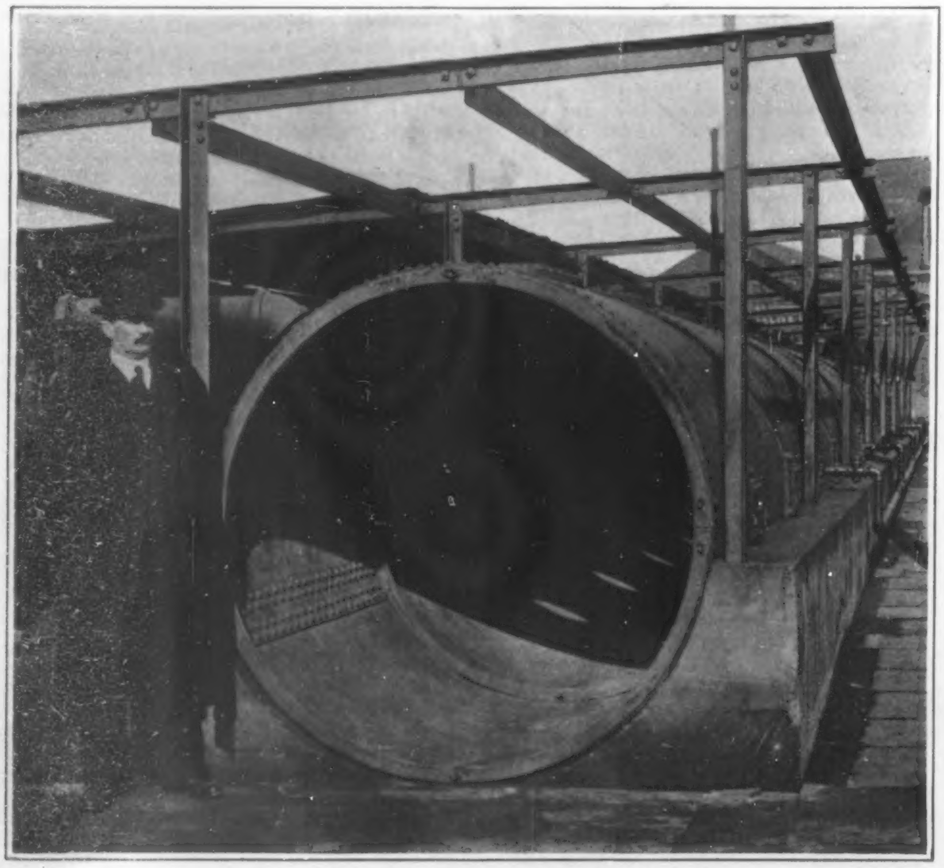
Apparatus for testing safety lamps under varying conditions of gas and coal dust.

With the pressing of a button the mortar is fired and the coal dust, or fire-damp, in the gallery explodes with a loud report. There are sixteen port holes along the side of the cylinder, and the miners are told to note by these how the blaze of the explosion progresses along the tube from the mortar to that covered with the paper drumhead. The explosion, of course, blows the paper out, and at the same time sixteen iron doors over a row of as many openings along the top of the cylinder fly up on their hinges. These doors and the drumhead save the entire plant, of course, from being totally wrecked by the explosion. As it is smoke pours out of the tube and there is a loud detonation. This test gives many miners their first demonstration of the fact that coal dust is highly explosive and teaches them much that they should know about the explosiveness of firedamp. At the same time the apparatus demonstrates the comparative safety of different explosives purposely used as blasts. Charges of dynamite, black powder, and various "safety explosives" are fired off from the mortar in the presence of coal dust and fire damp for the miners to watch their comparative effects and learn the strength of the charge of each that can be used without danger of an explosion. It is the aim of the new bureau of mines to standardize mine explosives, and it hopes in time to have only those used all over the country which these tests prove are comparatively safe.

In order to demonstrate to the miners that some of the safer explosives are at the same time the most powerful, there is a pair of mortars placed mouth to mouth, one mounted upon a little car that runs on a track, and the other swung as a pendulum from a great beam with a knife-blade edge designed to reduce friction. This edge rests upon a bar placed across two high pyramids of concrete. When the mortars are fired together the suspended one flies backward with a pendulum swing, whose distance, recorded by a scale, measures the power of the explosive.

A gallery thirty feet long and ten feet in diameter is used to show how a mine may be blown up by sparks from defective wiring in the mines. The gas and dust pumped into this tube are fired by a simple electric spark flashing between the two ends of wire.

In the lamp testing gallery the miners are taught



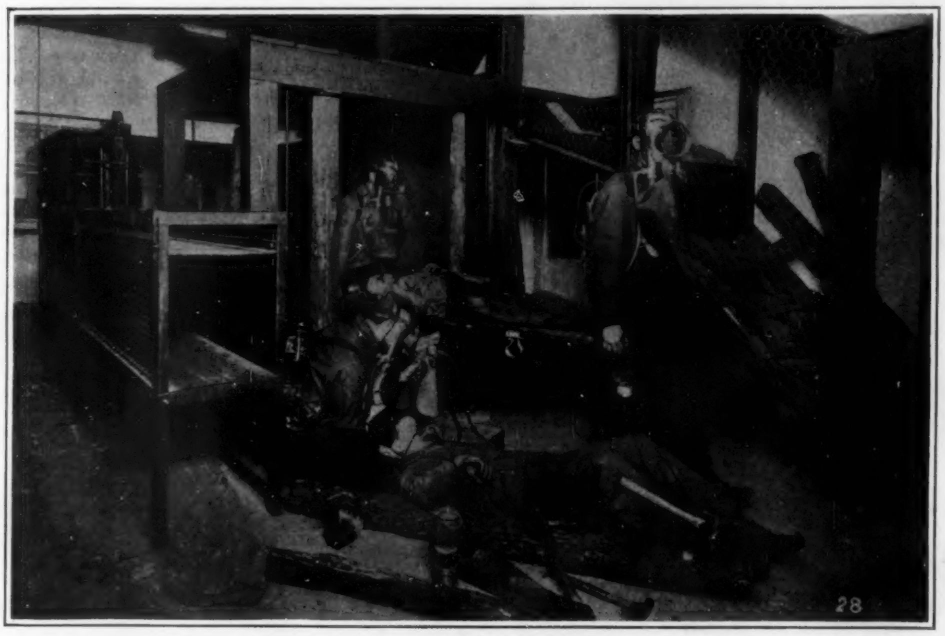
Big tube for producing sham mine explosions.

HOW THE GOVERNMENT IS TEACHING THE MINERS TO SAVE THEMSELVES

that "safety lamp" is often a misnomer or a trade name. The apparatus used to illustrate this lesson is a long, square tube which covers one side of the gallery built for this purpose, and here and there are trap doors of little compartments, into one of which a lighted lamp is placed. After which the door is shut, and a current of gas is blown through the tube. In this way the unsafe lamp, which explodes, is distinguished from the properly constructed safety lamp. Below the main tube is a W-shaped box with compartments in which lighted lamps are exposed to currents of gas coming at them from various angles.

As accidents will happen notwithstanding all efforts to prevent them, the miners are taught in a mimic coal mine what to do in dread times of fire and explosions. This is a large glass-incased air-tight room which contains difficult passages, such as exist in coal mines. There are also various obstructions similar to those found in a disrupted mine. Dummies are provided, weighing from 150 to 200 pounds each, representing asphixiated miners. This room is actually filled with sulphur gas, and the rescue corps of men who are being trained in the work enter daily, wearing oxygen helmets, and remain two hours removing obstructions, picking up dummies, giving them emergency treatment, placing them on stretchers, and carrying them away.

The rescue car of the Bureau of Mines.



Mine rescuers at practice work. Passages and obstructions are supposed to represent conditions found after mine explosion.

In addition to these local schools a number of traveling schools or mine rescue cars are engaged in spreading the knowledge that saves lives. These cars are fitted up with all kinds of life saving apparatus, and carry an instructing corps of practical miners trained in rescue work. These schools go to the miner in his own camp or town and stay long enough at each place to thoroughly advise him of the necessity for care and the many other apparently little things, all of which have a great deal to do with many of the explosions which occur in the mines. Each of the six cars which the government proposes to have on the road in a short time will have a certain territory to cover, but the headquarters of each will be as follows: Car No. 1, Pittsburg, Pa.; car No. 2, Urbana, Ill.; car No. 3, Rock Springs, Wyo.; car No. 4, Billings, Mont.; car No. 5, Salt Lake City, Utah; car No. 6, Knoxville, Tenn.

Each car will be manned with a mining engineer, a surgeon of the American Red Cross Society, and assistants who have been miners themselves. Illustrated lectures and moving picture shows will be given on the use of explosives, how to prevent fire in mines, the proper ventilation of the mines and first-aid surgical treatment. Each of these cars will contain a number of oxygen helmets, a supply of oxygen in tanks, a dozen safety lamps, a field telephone with 2,000 feet of wire, several life-saving outfits, and a small outfit for use in teaching the miners the principles of first aid to the injured. One end of the car is to be fitted up as an air-tight room, which will be used in training the men in the use of the oxygen helmets. This room will be filled with poisonous gases, and the miners wearing the helmets will remain inside the room for two or three hours in an atmosphere that would kill at once without the helmets.

In this way the miners are to be made thoroughly acquainted with the use of the helmets. In the perfect mechanism of the oxygen helmet, science and invention have indeed come to the rescue of the men who toil underground. The life-sustaining breath is in the form of compressed oxygen stored in a cylinder which is carried on the back, the oxygen being connected with the operator's mouth by a flexible, rubber-lined, metallic tube. The exhalations are passed through small lumps of potassium hydroxide, which absorbs the carbonic acid gas, after which the nitrogen, together with more oxygen from the cylinder, is again available for the operator.

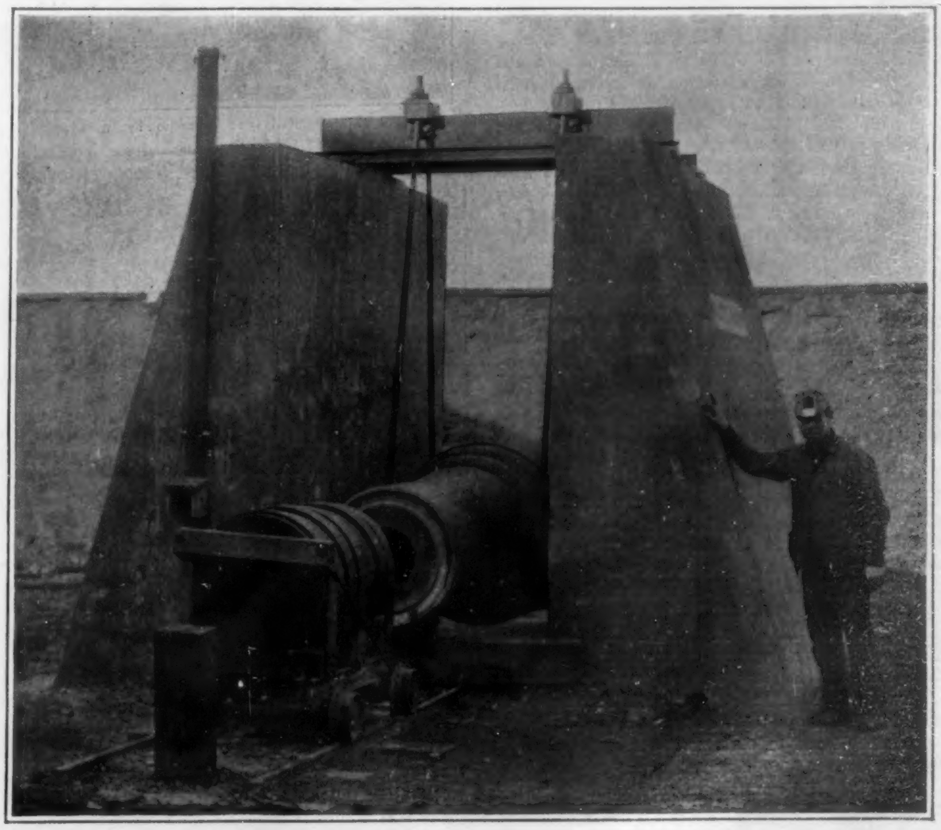
How eight to ten thousand of our miners are now being killed and injured every year, has been told over and over in our papers and magazines. This annual havoc equals the mowing down of ten to a dozen regiments of soldiers. In five years, more than a regiment has been killed outright in the Pennsylvania coal mines alone. During the past twenty years these black coal mines of ours have killed 30,000 men, made 11,000 widows and 30,000 orphans. It seems time for the government to make strenuous efforts to overcome the ignorance which caused most of the fatalities.

Wanderings of Ulysses

ULYSSES did not only wander in the Homeric myth, but wandered considerably in the theories of modern archæologists. The idea that the little rocky isle that proclaimed its identity with ancient Ithaca was the city of Ulysses's allegiance, was not attacked definitely until 1903. Then Dr. Doerpfeld, director of the German Archæological Institute at Athens, advanced reasons for regarding Leucadia as the city of Ulysses. A few weeks ago Dr. Cawadias, of the University of Athens, advanced a new theory based upon recent excavations. He selects the Ionian island of Cephalonia for the honor, basing his claim on the hundred Mycenæan tombs discovered there.

Paper Sensitive to Ultra-Violet Rays

MOST photographic papers are affected only by luminous rays and ultra-violet rays a little beyond the limit of visibility. A paper which is especially sensitive to ultra-violet rays has lately been produced. It is prepared with nitrite of paraphenylenediamine and turns blue when exposed to ultra-violet rays.



Testing the power of explosives used in mines.

HOW THE GOVERNMENT IS TEACHING THE MINERS TO SAVE THEMSELVES

Science in the Current Periodicals

In this Department the Reader will find Brief Abstracts of Interesting Articles Appearing in Contemporary Periodicals at Home and Abroad

Experimental Mechanics

TIMES have changed. Engineering has become so much of a great lady as to compel the respectful attitude of mathematics, and to make her connection with trade rather a recommendation than otherwise. In other words, the world must have engineers, and engineers must have mathematics, and, therefore, mathematics has become more practical. Moreover, in the engineering profession itself the problems which require solution become more and more of a kinetic nature. The strains and stresses in girders and embankments are as important as ever; but, in addition, the mechanics of movement is growing in importance. We move faster nowadays, not only on the railways, but on the roads, in the water, and even in the air. Hence it is that the practical teaching of mechanics, which used to be limited to a few experiments with spring balances and pulleys, has now spread into the region of kinetics. The concepts of force and work are undoubtedly best approached by practical measurements of the efficiency of simple or complex machines; and it has been found that velocity, acceleration, kinetic energy, moment of momentum, and other concepts involving movement can best be realized in a practical manner.

In a striking article published in *Knowledge*, Mr. W. D. Eggar points out concretely the relation between the sciences of experimental mechanics, engineering and metrology.

"The measurement of time," he begins, "has always been a difficulty in the way of those who have tried to teach kinetics by experiment. Electric chronographs are expensive, and even where expense is no bar, they are frequently found wanting either in their working or in their power of elucidating the problems in which they are employed. A recent adaptation of the old tuning-fork method of measuring time has revolutionized schools of dynamics. The tuning-fork method will be best understood from a glance at Fig. 1, which shows an arrangement for allowing a plate of glass to fall so as always to be in contact with a style attached to one prong of a tuning-fork vibrating with known frequency. A wavy curve is traced on the glass by the vibrating point, and the space fallen in a given time can be determined by measuring the length of that portion of the wavy curve which contains a number of waves corresponding to the given time. Another apparatus for measuring the velocity of the rim of a flywheel by means of a tuning-fork is shown in Fig. 2. Now a tuning-fork is not very easy to manipulate, and it goes rather too fast for beginners. Here it is that a great simplification has been made by Mr. W. C. Fletcher. A strip of steel clamped at one end carries a paint brush at the other end. A long trolley carrying a strip of paper moves underneath this paint brush in the direction of the steel rod's length. Suppose the steel to vibrate ten times a second, then the paint brush will trace a wavy line on the paper, and ten waves will represent the distance travelled in one second. The lengths of the waves give the velocities, and the changes in the wave lengths give the accelerations. Fig. 3 gives an example of the way in which Fletcher's trolley may be employed for measuring the acceleration when the trolley is allowed to run down an incline. One of the curve tracings made by the paint brush is shown resting by the side of the plane. As for the way in which the acceleration is determined from a curve of this kind, let us consider the curve shown in Fig. 4. Placing a centimeter scale along its wave crests, we can read off the distances of these crests from the starting point of the curve to the nearest half millimeter, thus 0.1, 0.35, 0.8, 1.45, 2.25, 3.2, 4.35, 5.65, 7.1, 8.7 10.5, 12.4, 14.5, 16.75. From this, by subtraction, we obtain the successive wave-lengths, viz.: 0.25, 0.45, 0.65, 0.8, 0.95, 1.15, 1.3, 1.45, 1.6, 1.8, 1.9, 2.1 2.25. It is obvious from this that the wave-length has been increasing fairly uniformly the successive increments in wave-length being again obtained by subtraction Thus they are 0.2, 0.2, 0.15, 0.15, 0.2, 0.15, 0.15, 0.15, 0.2, 0.1, 0.2, 0.15. The average of all these is 0.167. Now, since the wave-lengths correspond to periods of one-fifth second, it is plain that the average increase in the space travelled in each one-fifth second is increasing at the rate of 0.167 centimeter in every one-fifth second. Hence in each second the increase in the velocity is 5×0.167 centimeter per one-fifth second, or $5 \times 5 \times 0.167$ centimeters per second. The acceleration is therefore 4.17 centimeters per second.

As an example of the way in which the apparatus may be employed we may take the verification of the law "Acceleration is proportional to the accelerating force." The variable force is obtained by varying the slope of the plane. To avoid having to consider the force of friction, the trolley is first connected by a string passing over a pulley, shown in the figure, to a scale pan of known mass, and weights are added just enough to prevent the trolley from accelerating when it is given a start down the plane. When the waves made by the paint brush are of equal length the total force down the plane is exactly balanced by the scale pan and weights. Now if the string is removed the trolley will accelerate under a force which is equal and opposite to that which has been removed, viz., the weight of the scale pan and its contents. The acceleration can be measured as before. If the observations are now repeated with a different angle of slope the two accelerations will be found to be in the seme ratio as the two accelerating forces. An approximate verification of Newton's Second Law may seem unsatisfactory; but the method has the merit of making the notion of acceleration much more easy for the ordinary mind to grasp.

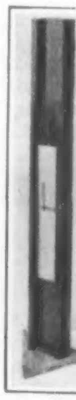


Fig. 1.

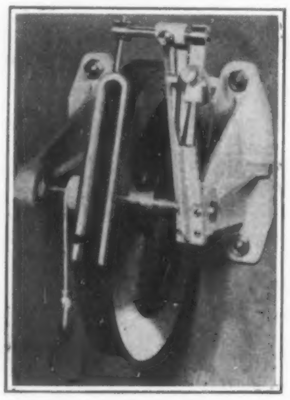


Fig. 2.

Fig. 1.—Apparatus for measuring time with a tuning fork.
Fig. 2.—Measuring the velocity of the rim of a wheel.

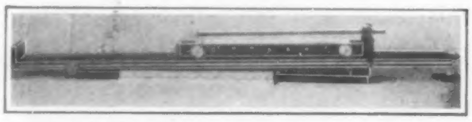


Fig. 3.—Fletcher's trolley for measuring acceleration.

Fig. 4.—Wavy curve showing acceleration.

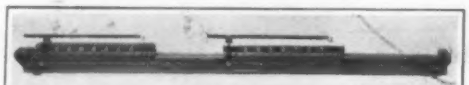


Fig. 5.—Two trolleys for verifying the laws of momentum and impact.

Fig. 6.—An inertia bar set in motion by a trolley.

Fig. 7.—A vibrator for measuring the angular velocity of a fly wheel.

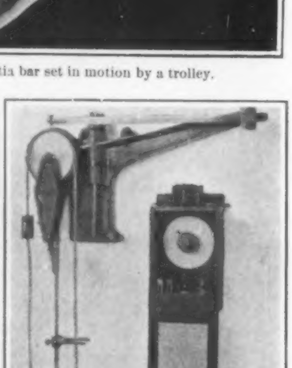


Fig. 8.—The vibrator adapted to an Atwood's machine in which a paper ribbon replaces the string.

NEW EXPERIMENTAL APPARATUS.

Fig. 5 shows how, by means of two of these trolleys, laws of momentum and impact may be verified. In one form of the apparatus, employed by Mr. Ashford, at Dartmouth Naval College, one trolley carries a pistol and the other a target in which the bullet embeds itself. After the shot the trolleys retire with equal momenta.

Fig. 6 shows an inertia bar, which is set in rotation by the impact of a trolley. Vibrating springs are employed as before to measure the momentum of the trolley, and the angular momentum of the bar.

Fig. 7 shows the vibrator employed in measuring the angular velocity of a fly wheel. The notion of kinetic energy becomes clearer after a series of measurements taken with an apparatus of this kind.

Mr. G. Cussons, of Manchester, to whom we are indebted for the photographs used in illustrating this article, has adapted the vibrator to a form of Atwood's machine in which a paper ribbon replaces the usual string. The apparatus is shown in Fig. 8. Excellent results are obtained from this instrument, and Fig. 4 is a reproduction of one of the curves obtained from it.

Self-luminous Matter

ABOUT the year 1800 Vincenzio Casciorolo, a shoemaker of Bologna who dabbled in alchemy, discovered that heavy spar, or barium sulphate, which had been fused with other substances, emitted in cooling a blue light, which gradually became fainter, but increased in brightness when the mass was exposed to sunshine and then brought into a dark room, as if it absorbed and then poured forth the solar radiation. With the assistance of two local scientists, Casciorolo manufactured many of these luminous stones, which were sold all over Europe under the name of Bologna stones or Bononi stones, and which everywhere created great astonishment.

This property of "phosphorescence" is possessed, to some degree, by many substances, and very strongly by certain sulphides. Masses which exhibit beautiful violet, green, red, and yellow phosphorescence can be produced by heating the sulphates of the "alkaline earth metals," barium, strontium, and calcium, with minute quantities of sulphates of copper, bismuth, zinc, and other metals, together with deoxidizing agents, which reduce the sulphates to sulphides. The phosphorescence is excited most strongly by exposure to ultra-violet rays.

In commenting upon these phenomena, a writer in *Reclams Universum* remarks that there are other substances which, during their exposure to light, emit light which differs in color, or wave-length, from that which falls upon them. This phenemenon is called fluorescence. It is distinguished from phosphorescence by the peculiarity that it ceases the instant the illumination is withdrawn.

Phosphorescence and fluorescence have been studied very attentively, but their real nature is not yet thoroughly understood.

Phosphorescence of another sort is exhibited by many substances, and especially by the element phosphorus. Here the light is produced by a chemical process, a slow oxidation. The light of the glowworm, the fire-fly, and the countless minute phosphorescent organisms of the sea is due to a similar cause. The shining of the eyes of many animals at night, however, is probably caused by reflection of stray rays of light from without.

Decaying wood and other vegetable and animal matter, and fish and pork even while apparently fresh, are often luminous in the dark. This light is produced by microscopic organisms called luminous bacteria.

Phosphorescence is sometimes evoked by mechanical action. Sugar and many other substances emit light when they are crushed or broken in the dark. Finally, light may be produced by crystallization. When arsenic crystallizes from a solution, the formation of each crystal is accompanied by a flash of light.

Phosphorescence and fluorescence possess some practical interest. Mixtures consisting chiefly of calcium sulphide are employed to make match safes, the dials of watches and clocks, and other articles, visible at night. The phosphorescence of phosphorus is employed in the detection of that substance, in cases of poisoning. The contents of the stomach are distilled

in a glass retort and receiver. If phosphorus is present a luminous ring of condensed phosphorus appears, in darkness, on the inside of the cooled receiver.

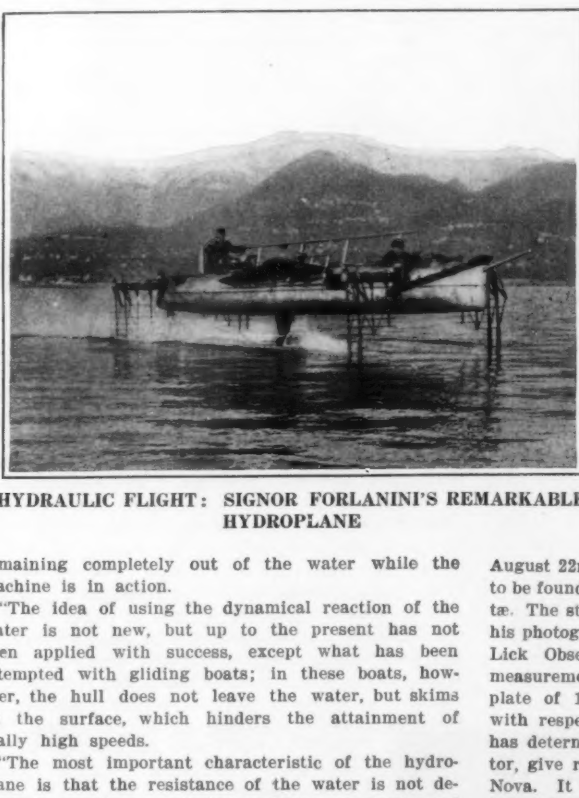
The most important scientific applications of phosphorescence and fluorescence are in the new field of radioactivity. Roentgen rays and the rays emitted by radioactive bodies produce luminescence in zinc blende, barium platino-cyanide, and other substances, and thus the presence of these rays can be detected. The fluorescent screen, which shows the "skiagraph" of the bones of a hand traversed by Roentgen rays, is coated with barium platino-cyanide. The particles which constitute the alpha rays of radium, and which are ultimately transformed into atoms of helium, produce little points of light when they strike a screen coated with zinc blende. Each bright point represents one alpha particle. In this way the existence of a single atom was first demonstrated to the eye.

Hydraulic Flight

QUIETLY at work since 1905, a clever Italian engineer, Ing. Enrico Forlanini, of Milan, has succeeded in producing a remarkable craft. It is a hydroplane on quite new lines, and is now being thoroughly tested on Lake Maggiore.

The inventor has furnished *The Car* with the following:

"The apparatus has been patented under the name of "Appareccio Idrovolante" (Apparatus for Hydroplaning). In fact, it constitutes true hydraulic flight, the apparatus being sustained by the water in the same manner that birds and aeroplanes are sustained in the air; that is to say, by the dynamic reaction of the water on the superficies or planes attached to the hull of the hydroplane, most of these planes



HYDRAULIC FLIGHT: SIGNOR FORLANINI'S REMARKABLE HYDROPLANE

remaining completely out of the water while the machine is in action.

"The idea of using the dynamical reaction of the water is not new, but up to the present has not been applied with success, except what has been attempted with gliding boats; in these boats, however, the hull does not leave the water, but skims on the surface, which hinders the attainment of really high speeds.

"The most important characteristic of the hydroplane is that the resistance of the water is not dependent on the speed, but remains constant, and is equal to half the total weight of the apparatus; the total resistance is increased only by a portion of resistance due to the air, a portion naturally proportional to the square of the speed. In consequence, similar hydroplanes in the future should be able to attain speeds of 60 to 100 miles per hour, and change themselves into flying machines by the addition of the necessary planes for aerial suspension."

After six years of experimenting, Ing. Forlanini can now consider that he has arrived at fully satisfactory and definite results. The first hydroplane he tried during the years 1905, 1906, and 1907, immediately demonstrated the excellence of the new system, but its performances were always handicapped by the irregular working of a bad 70 horse-power motor, with which it was fitted. Another hydroplane, tried during the years 1908 and 1909, was fitted with a steam motor that worked more regularly. Although the effective power was only 25 horse-power, and the weight of the boat over a ton, this machine attained a speed of over 50 kilometers per hour.

The hydroplane that is being tested at present weighs two tons when there are two persons aboard —it is possible to carry four other persons—and is fitted with a 100 horse-power gasoline motor. It has attained a speed of 45 miles per hour, and this speed will be increased by the introduction of a few modifications that are being gradually indicated during the trials it is now undergoing. This hydroplane has a hull 32.8 feet long; at the bows and stern are two strong steel tubes, about 11½ feet long, fixed transversely. At the four free ends of these tubes—namely, on the starboard and port sides of the boat—is fixed a sort of framework which contains a series of planes, one above the other. A glance at our illustration will more clearly explain the nature of these frames or grids, which somewhat resemble large venetian blinds. These superficies or planes are made of high-resistance steel, the workmanship being very accurate, and their size decreases from the top to the bottom.

When the hydroplane is not working, but is floating on the water like any other ordinary boat, the planes are immersed in the water and have a slight horizontal inclination. Immediately the hydroplane, owing to the working of the screw begins to move forward, the water exercises a vertical force on the planes in precisely the same manner as the air on the planes of an aeroplane; the hull, therefore, tends to rise and so diminishes its immersion and naturally the resistance against its motion, in a manner that the speed is able to increase. In this way there comes a moment when the hull is completely out of the water. At this point the speed rapidly increases, and little by little the various planes or superficies rise out of the water one after the other. When the maximum speed is reached, only the bottom planes remain on the water, while the bottom of the hull is sixty-five centimeters higher.

The propeller by which this strange craft is driven is carried on a hollow fin which may be seen amidships, the short propeller-shaft being revolved by bevel gears attached to a vertical, intermediate shaft, driven direct off the motor.

Although the illustration shows the hydroplane speeding along in smooth water, it must not be inferred that it can be used only under these conditions, as a matter of fact, it has been tested when quite a 'gh wind has been blowing, accompanied by the type of short waves one gets in sheltered waters, and with perfect success. It is also stated to steer very well, and to be able to turn in a much smaller circle than one would imagine to be the case. The short outrigger or bowsprit, is carried to assist the helmsman in his task, as it serves as a pointer.

Prediscovery Photographs of Espin's Nova Lacertae

IN the *Astronomische Nachrichten* Prof. E. E. Barnard publishes a note to the effect that on three of his photographs taken with the 6-inch and 10-inch lenses of the Bruce photographic doublet on 1907, August 7th, and 1909, August 22nd and 24th, a fourteenth magnitude star is to be found in the exact position of Espin's Nova Lacertæ. The star also shows clearly and strongly on one of his photographs made with a 6-inch Willard lens of the Lick Observatory on 1893, October 11th. Careful measurements of the position of this small star on the plate of 1907, August 11th (47 minutes' exposure), with respect to seven small stars whose positions he has determined visually with a 40-inch Yerkes refractor, give results which agree with the position of the Nova. It would, therefore, appear that the Nova before this outburst for at least 17 years existed in its present state as a fourteenth magnitude star. The images on the various plates seem to show that the star was perhaps subject to fluctuations of at least one magnitude.

Prof. Barnard states that in the 40-inch telescope of Yerkes Observatory the image of the Nova exhibits the same peculiarity as Turner's Nova Geminorum of 1903, in having two distinct and sharp foci. One of these images is at the ordinary focus and has but little color, being surrounded by a reddish glow. The other, equally sharp, and of a peculiarly crimson color surrounded with a greenish gray glow, is 8 milimeters farther from the object glass; the measures give January 3d, 8.9 millimeters; January 8th, 7.6 millimeters; the difference doubtless being due to conditions of seeing.

Prof. Barnard adds that he has never seen this peculiarity in other stars and explains it by the great brilliancy of the crimson alpha line of hydrogen in Nova Lacertæ, as is shown on spectrograms made at Yerkes Observatory by Prof. Frost and Mr. Parkhurst.

The Expositions at Turin and Rome

OF the two expositions to be held in Italy, the one at Rome commences on March 27th and the second at Turin on April 29th, and both last until the end of November. It may be a matter of surprise that two expositions are to be held at the same time in the same country, but the fact is they are conjointly organized and do not conflict. The Turin exposition lying in the northern industrial region will represent manufactures and commerce, while the one at Rome will bear upon artistic, ethnologic and historic subjects, thus completing the former. Each of these centers thus has an exposition which represents one portion of the progress of the country which properly belongs to it.

Foot Rests and Their Dangers

FOOTSTOOLS and other foot rests cause many more or less serious accidents, simply because the top of the stool almost invariably projects beyond its feet or base. Foot rests are used more extensively than is commonly supposed. The more or less ornamental footstool (Fig. 1), is a familiar household object, and foot rests of diverse forms, specially constructed or improvised, are employed in many workshops and factories, not only to support the feet while

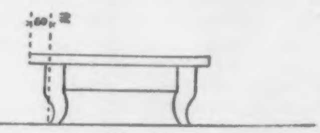


Fig. 1.—The household footstool.

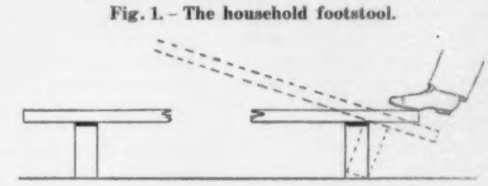


Fig. 2.—The delusive bench.

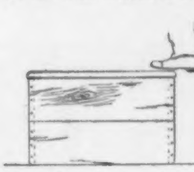


Fig. 3.—The treacherous inverted box.

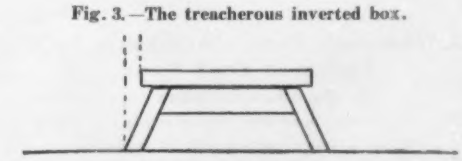


Fig. 4.—A safe foot rest.

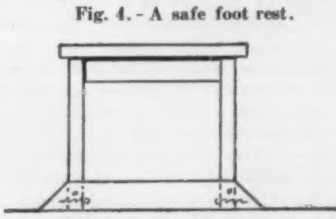


Fig. 5.—Safety attachment for stools.

Fig. 6.—Safety attachment for boxes.

FOOT-RESTS GOOD AND BAD

sitting, or one foot while standing, but to stand on while at work. A German engineer, who discusses the subject in *Die Umschau*, found girls standing on piles of two or three boxes in order to tend tall machines in a certain factory. In another establishment a large bench, constructed as is shown in Fig. 2, was used for piling sheets of paper. The operatives appeared to delight in stepping on this bench whenever it was empty, although numerous falls were caused by the tipping of the bench. Yet nobody took the trouble to secure the bench against tipping. In such conditions it is not surprising that serious accidents often occur. Even a box or bench of equal dimensions at top and bottom (Fig. 3), is apt to upset when carelessly stepped upon. Mutual benevolent societies have incurred heavy expense through accidents of this character.

The only safe foot rest is one whose base is considerably larger every way than its top (Fig. 4), and most of the foot rests now in use whether of the stool, bench or box type, can easily be made reasonably safe by securely fastening four beams of triangular section to the feet or base, as shown in Figs. 5 and 6.

[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

Liquefaction of Nitric Oxide

To the Editor of the Home Laboratory:

In the issue of January 21st, there is an article for amateurs on "The Liquefaction of Nitric Oxide," which should never have appeared in your columns. Mr. Bowen has very unfortunately selected for his experiment a gas which, until the year 1877, had been considered incoercible that is non-liquefiable. He might better have selected the dioxide of sulphur or the dioxide of nitrogen, both of which succumb readily to liquefaction.

In the year 1877, Cailletet first liquefied nitric oxide by expanding the gas from a pressure of 104 atmospheres and at a temperature of —11 deg. C. This is a similar method to that for the liquefaction of air at the present time. The expansion produces extreme cold. To liquefy nitric oxide a temperature of —93.5 deg. C. must be obtained, this being the critical temperature, a temperature above which a gas cannot be liquefied. With this temperature a pressure of 71 atmospheres must be produced (Olszewski). This is the critical pressure for the critical temperature of —93.5 deg. C. It is because of not having these extreme conditions that the gas was thought to be non-liquefiable. Prof. Dewar has succeeded in both liquefying and solidifying nitric oxide.

The experiment cited in your columns is an utter impossibility, for the temperature attained approximates at best —20 deg. C. and the pressure is that of one atmosphere. J. H. Graham.

Professor of Chemistry, Central High School, Philadelphia, Pa.

A Home-made Portrait Attachment for a Camera of Fixed Focus

By Albert S. Getten

THE following describes the manner in which a portrait attachment was made for a pocket camera of fixed focus.

A spectacle lens was fastened over the aperture of the camera by rubber bands (shown in photograph) and a piece of ground glass, substituted for the film, was placed in the back of it. The object to be photographed was then moved in front of the lens until a clear image was formed on the glass.

The principle is very simple: The regular lens of the camera is placed so far from the film that the image of an object, removed to a certain distance from which the light rays striking the lens are parallel or nearly so, will be formed sharply and clearly. For an object, however, within a foot or so the image will be formed back of the film and consequently a blurred picture will be the result. The only ways to correct this are to either move the film back to the place where the clear picture is formed or else to shorten the focus of the lens. As the first is impossible in a kodak of fixed focus, the last must be resorted to. This is accomplished by placing another lens over the first, the focus of this one determining, of course, the range of the camera.

The approximate focii of the spectacle and camera lenses which I used are 9 inches and 4½ inches, respectively. The first was fastened over the other 1 inch from it, while the object photographed was 9 inches from the camera.

The first portrait attachment which I had I bought for that purpose, but its focus was so long that an object could be brought no closer than 3½ feet to be photographed with distinctness, so I made the attachment above described. This has not only worked with remarkable distinctness, but permited me to get a half-size picture of the object. (The "Billikin" is 5 inches high, while his picture is 2½ inches.)

In order to get a photograph of the camera with its attachment, it was necessary for it to take it's own picture, no other camera being available. This was accomplished by placing it 4½ inches from a mirror and letting the film expose two minutes.

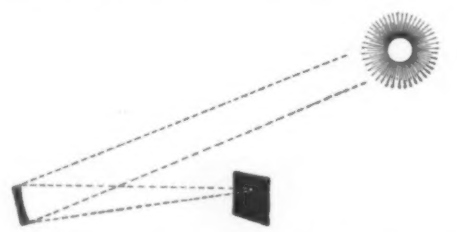
Portrait taken with a pocket camera.

The camera taking its own picture.

Construction of a Four-and-a-Half-Inch Reflector

By Albert R. J. F. Hassard

IN view of the recent revival of interest which has taken place in astronomical studies and of the frequent letters I have received from different quarters of the world, inquiring how the writers might construct inexpensively for themselves telescopes, I venture to contribute a few sentences to this journal. Like your contributor, Mr. Mellish (Scientific American, October 1st, 1910) I have made several large instruments, which have given much satisfaction. But since very large telescopes are difficult to make, particularly for those who are inexperienced, it is my desire to explain merely how I have made a small 4½-inch reflecting telescope at a very trifling expense. The entire cost has not much exceeded one dollar. Being a lawyer by profession, it has been only during spare moments in the evenings or mornings and on holidays that I could give attention to this interesting recreation. The first telescope I made took me about a year, the last only a few hours.



Testing the focus of the reflector.

First, to make a 4½-inch reflector, it is necessary to procure a piece of plate-glass 4½ by 9 inches. With a ten-cent glass cutter cut this across in the center, making it into two squares each 4½ inches square. With the glass cutter draw a 4½-inch circle on each square, and with a few scorings of the cutter into the glass in various places outside the circles, and also the help of a pair of pliers, the surplus glass can be cut off without much trouble, and the circles left in quite a presentable condition. By running the edges on a grindstone, the circumferences of the circles may be made both smooth and fairly true.

Now cement one circle to a corner of the work bench, and to the other cement a large cotton spool or similar piece of wood. A piece of a cylindrical curtain pole 1½ inches in diameter and 3 inches long will do. The cement used is merely pitch—common black, hard pitch. On the surface of the disk of glass cemented to the work bench lay a half teaspoonful of sand, emery, or carborundum; if emery or carborundum, use grade about 40. Wet it slightly, and rub one glass on the other, by keeping the motion crossways across the lower glass, so that the upper glass crosses the circumference of the lower glass about 3 inches back and forth. Keep moving around the bench, and keep revolving the upper glass by the handle, so that never twice will the two glasses cross one another in the same direction. By this irregularity of movement comes the regularity of figure. In a minute or two fresh sand, etc., will be needed; and by one-half hour it will be found that the upper glass is concaved while the lower one has become convex.

Now wet the surface of the upper glass and hold quickly the wet face to the sun; watch where the sun makes the best and smallest image on a screen, as in the accompanying drawing. If this be about 4 feet from the mirror's surface, it is time to stop the coarse grinding, which so far has proceeded; if the distance be longer, proceed with the grinding as directed further until that distance is attained. Then procure finer sand or finer carborundum or emery, and grind with it, only use shorter strokes. Continue using finer and finer sand, etc., until all the small holes in the glass disappear and until the surface becomes quite smooth. Then procure about 1 pound of "flour" emery, which is like a grayish dust. Pour it into about 2 quarts of water, stir it thoroughly for a few minutes, then let it rest for 20 seconds. Carefully and quickly pour off all the water, and it will be found that only the coarser or heavier emery will be left. Keep it by itself in a small jar or bottle, and label it "No. 1." Then stir up the water which was poured off, for a minute or two, and allow the mixture to stand a minute. Then pour off the liquid quickly and carefully, and mark the emery left in the bottom "No. 2." Continue thus, only allow the liquid to rest after the second time as follows: Three minutes, 7 minutes, 20 minutes, and 1 hour. In this way the last emery will be of the finest possible character, and the liquid will be of a ruddy color. The last emery will be "No. 6." Grind about 10 minutes with each grade, beginning with No. 1, and by the time No. 6 has been used, the surface of the glass should be exquisitely fine, and without either hole or scratch. Should such not be the case, return to a coarser grade of emery, and use it until the holes made by the prior grade are removed. When No. 6 is finished, the glass should be almost transparent.

Now on top of the glass cemented to the bench, pour some melted black pitch; wet the upper glass and press it on the pitch, so that the surface of the pitch may take an impression of the face of the upper glass. Trim away the pitch where it is larger than the glass. Then procure 1 ounce of jeweler's rouge (it is also known as the red oxide of iron), lay a small quantity of it on the pitch, wet it, and revolve the upper glass on it diligently. An hour of this will bring the surface of the upper glass to a polished condition, and a further treatment will polish the glass completely. Now try it without its being wetted at all on the sun, as illustrated, and the image of the sun will be seen quite distinctly. It will not matter if the 4-foot measurement be reached exactly. I have one glass with a 3-foot focus, and in another the focus is 4 feet. The surface of the glass must be true to thousandths of an inch, and this can be tested only by what is known as the Foucault test, which space does not permit me to explain here. The glass must be washed in a bath of anything which will make it chemically clean. I generally use 60 grains bichromate of potash, 2 ounces water, 5 drops sulphuric acid, though this may be strengthened if required. Then silver the glass thus: Twenty-five grains nitrate of silver dissolved in 2 ounces water. Drop into this ammonia until it first blackens, then becomes almost (but not quite) clear again. If it becomes clear again, add a few grains more of nitrate of silver. Then dissolve 25 grains of chemically pure caustic potash (in stick form) in 2 ounces of water. Mix it with the nitrate of silver, water, and ammonia. All will turn black. Then add slowly drop by drop ammonia again, and it will begin to clear. All the while stir it with a piece of wood or glass rod. Then add a small solution of nitrate of silver and water (10 grains nitrate and 1 tablespoonful of water) until the liquid which was nearly clear begins to get a little darker or ruddy. Lay aside. Call this solution A. Make solution B thus: Six ounces pure water (boiled), 1 teaspoonful of white sugar, 1 teaspoonful of pure alcohol, 3 or 4 drops of nitric acid. This grows better as it grows old. To solution A add 3 teaspoonfuls of solution B, and put it into a saucer. Stir rapidly for one-half minute. Then immerse the glass, concave side down, so that this side of the glass is fully immersed in the liquid. In a few minutes the silver will be seen rising and adhering to the glass. In about 10 minutes the glass will be fully covered, when it may be withdrawn. Let some cold water run on the silver face of the glass for a few minutes, and set the glass on edge to dry. At the same time silver a small piece of flat plate glass similarly. Let the piece be 1¼ × 1¾ inches measurement. Cold water running on the newly-silvered surface will do no harm, but on the contrary, good. The tube should be of tin or stovepipe iron, 5 inches in diameter by about 4 feet long. The two glasses should be so fixed and supported in the tube that the light of the moon or a star, etc., should pass down the tube, strike the hollowed out (and silvered) surface of the 4½-inch mirror, then pass from it up to the small mirror, which it should strike at an angle of 45 degrees, after which the light should emerge through a hole in the side of the tube,

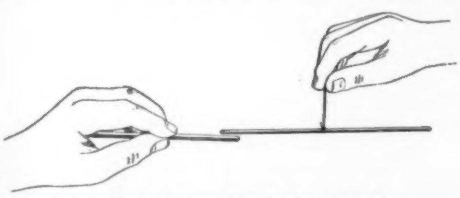
where an eye-piece must be placed. At that point, when one looks through the eye-piece, there will appear, many times enlarged, the object at which the telescope is directed.

Graphic Demonstration of Cometary Orbits

By B. C. Batcheller

EXCEPT for those familiar with higher mathematics and physics, it is difficult to understand how a comet can approach the sun with an ever-increasing speed, sweep around so close to it, and then move away without being drawn into it by the tremendous force of gravitation.

The motion of the comet relative to the sun can be illustrated in a simple manner with two permanent magnets. One magnet may be made of a straight piece of steel wire 8 inches long and $\frac{1}{8}$ of an inch diameter, the other of a straight steel rod 6 inches long and $\frac{1}{4}$ of an inch diameter—the exact size is not important. Both must be hardened and magnetized as strong as possible. Suspend the longer magnet like a compass needle, by a fine thread tied to the middle, and set it swinging through a wide angle in a horizontal plane by means of the other magnet held in the hand. As the north pole of the suspended magnet swings, say, from left to right, bring the south pole of the shorter magnet, held horizontally in the hand, to a position just beneath the plane in which the suspended magnet is swinging, so that if it continued to swing in that plane, its north pole would pass over the south pole of the magnet held in the hand. If the south pole of the magnet held in the hand is brought too near to the plane of the swinging magnet, then the two poles will be drawn together. On the other hand, if the south pole of the magnet held in the hand is not brought near enough to the plane of the swinging magnet, then the north pole of the swinging magnet will pass the stationary south pole with only a slight deflection. If the south pole of the magnet held in the hand is brought to just the right distance



A cometary orbit produced with magnets.

from the plane of the swinging magnet, then the north pole of the swinging magnet will describe an approximate arc of an ellipse around the south pole of the magnet held in the hand, passing quite close to it, but not touching it, as the comet passes around the sun. The pole of the swinging magnet moves with an accelerated speed as it approaches the pole of the stationary magnet, and with a retarded speed as it recedes from it, in accordance with a similiar law to that which accelerates and retards the comet in its path around the sun.

The first few attempts to perform this experiment will probably result in failures, but a little patience is sure to be rewarded with success. I did it the first time by accident, but since then have repeated the experiment many times.

A Modified Form of the Opeidoscope

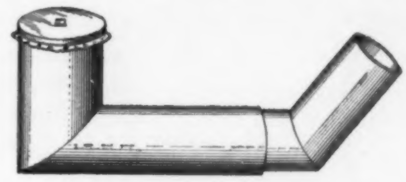
By C. S. Bourne

IN studying the vibrations of forks or of membranes, it is of great interest to the experimenter to make those vibrations optically apparent.

The opeidoscope—so called by Prof. A. E. Dolbear, who devised the little apparatus some years ago—provides a simple device for producing that effect. It consists of a tube of tin or paper several inches long, with a membrane of very thin rubber tied over one end, to the center of which is glued a small bit of looking-glass about one-eighth of an inch in diameter. By holding it near the window in such a way as to reflect a small sunbeam to the white wall of the room, and then singing different notes into the open end, the sun spot changes and describes harmonic curves in response to the pitch of the voice and the peculiar vibrations of the membrane. At one pitch it will assume a straight line, again a well-defined ring, then an ellipse, and perhaps a figure 8, varying with the tone of the voice and the movement of the tube.

In experimenting with this simple device, the writer has experienced the same difficulty as others have in being obliged to assume an awkward and strained posture in order to reflect the sunbeam to the desired spot while at the same time holding the tube to the mouth. To obviate this, I constructed the instrument in the form of the sketch herewith shown, making an elbow in one tube and providing another slightly smaller, to slip inside, so as to easily rotate to any angle desired. With this arrangement one may direct the sunbeam with far greater ease than with the single straight tube.

Anyone may make this device with common paper mailing tubes, the parts to form the elbows being glued at the edges. The instrument is well worth the time spent in making it; and with the window shades drawn to darken the room as much as possible, it will be found an interesting source of amusement.



Improved opeidoscope.

In a school room provided with a heliostat, the effect would be enhanced.

An Easily Made Leyden Jar Charger

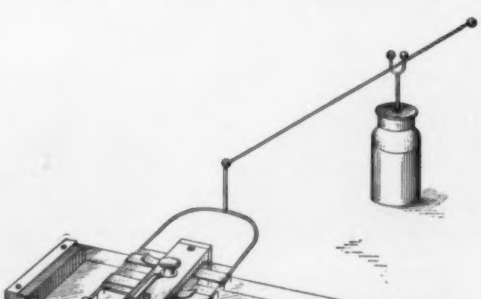
By H. B. Dailey

LONG before he has acquired the necessary manual skill to warrant an attempt to build for himself the somewhat difficult influence machine, many a youthful electrical enthusiast has at some time or another felt the longing to reproduce for his own benefit at home some of the fascinating experiments he has seen exhibited in electrostatic physics.

To such it should be interesting to realize that many of the most beautiful and instructive of elementary demonstrations of static electrical phenomena are among those that require only the single charge of a small Leyden jar for their presentation. Physiological effects; the puncturing of refractory materials, and other disruptive manifestations, such as the breaking of tightly corked glass tubes filled with water through which the discharge is passed; ignition of gunpowder and volatile fluids; momentary illumination of interrupted conductors; chemical union of oxygen and hydrogen in the gas pistol; the ringing of static electric chimes and various other interesting illustrations of electrical attraction and repulsion; simple experiments in Hertzian waves; these are but a few of the pleasing experimental possibilities of the Leyden jar and its single charge.

The simple arrangement here illustrated will charge a pint size Leyden jar to a high potential in a few moments. The apparatus requires no machine work in its construction and can be built in a few hours with common tools.

A strip of plate glass 8 x 33 inches, with parallel edges is supported at its ends upon shouldered cleats attached to a suitable baseboard, the glass being elevated about $2\frac{1}{2}$ inches above the board. An amalgam-coated, chamois-skin-covered, rubber block adapted to be moved back and forth by hand along the glass, carries a pair of insulated collecting combs which gather



Device for charging Leyden jars.

frictional electricity from the glass, transmitting it through an oscillating rod to a Leyden jar standing a short distance to one side of the charger. The body of the rubber block is formed of two superposed pieces of soft wood, each $\frac{7}{8}$ inches thick and 4 inches wide, having a length slightly greater than the width of the glass plate. Thin hardwood guide pieces shaped as in the illustration, attached to the ends of the rubber block, guide the movement of the latter by engaging the edges of the baseboard.

The collecting combs are carried by a rectangular insulating strip of plate glass measuring 6 x 10 inches which is clamped at its middle across its narrower dimension between the two halves of the rubber block, the upper half of which is channeled transversely to receive the glass. The collector combs consist of two rows of downwardly directed metallic points reaching nearly to the glass, attached to the under sides of the parallel limbs of a U-shaped loop of stout brass or copper wire, which is bound to the ends of the insulating plate with two or three tightly drawn bands of half-inch silk ribbon.

The points, which are placed about half an inch apart, are made by soldering short common pins by their heads to the collector rods, the rows of points being slightly shorter than the width of the friction glass on which the rubber glides. To keep the comb-loop from slipping off the ends of the insulating plate small holding clips made from rectangular strips of thin sheet brass, bent into U form, and measuring before bending $\frac{3}{8} \times \frac{5}{8}$ inch, are soldered round the body of the comb-loop at the point where the binding ribbon is to be applied, the ends of the clips extending a very short distance upon the surface of the insulating plate. Thick shellac varnish is applied to the inner surfaces of the holding clips and the binding ribbon applied over them, after which the insulating plate including the ribbon is well coated with shellac which renders the attachment permanently firm.

In making the friction pad, two thicknesses of chamois skin exactly the size of the rubber block are laid upon the block's under surface, a piece of tinfoil, of the same size is placed upon these, and a wider piece of chamois skin is drawn tightly over the whole, brought round the edges of the block and fastened with small tacks. The tinfoil within the pad is electrically connected with the hand-knob on the top of the rubber block through a narrow strip of tinfoil shellacked round the end of the block and along its top surface before the guide-pieces are put on. The pad is now charged with a thin coating of friction machine amalgam made adherent to the chamois skin by means of a very small quantity of lard applied to the rubber. Amalgam from the back of an old mirror answers fairly, but it is much better to buy a small quantity of the regular kind from makers of laboratory supplies.

A 4-inch piece of $\frac{1}{4}$-inch brass tubing soldered vertically on the bend of the comb-loop carries a slender oscillating rod which extends out horizontally between the ball-tipped prongs of the forked stem of the Leyden jar. The nearer end of the rod terminates in a $\frac{3}{4}$-inch metal ball provided with a vertical stem which turns freely in the tubular socket. To prevent the escape of electricity into the air the terminals of the comb-loop, oscillating rod, and jar fork are protected with smooth brass or leaden balls, and all projecting angles, and sharp corners are carefully avoided.

A few movements of the rubber along the glass charges the jar which may then be detached from the apparatus and its charge used in any desired manner.

An excellent Leyden jar for this arrangement can be made as follows: Secure a tall tumbler of thin blown glass and coat it within and without with tinfoil to about half its height, attaching the foil with shellac varnish nearly dried. Put several ounces of fine shot into the tumbler to give it stability.

Stand the forked stem vertically in the shot and pour melted paraffine into the tumbler to within $\frac{1}{4}$ inch of the top of the tinfoil coating.

If plate glass is not available for the apparatus double strength window glass is equally effective electrically; but should this be used the friction plate should be supported in several places with vertical pieces of glass tubing let into holes in the baseboard.

Like all machines of the frictional type the present apparatus requires the dry cold weather of winter for its most successful operation. Warming the friction plate and occasionally stirring up the amalgam on the rubber add considerably to the machine's effectiveness.

How Clouds Get Their Fringes

TYNDALL used to explain to popular audiences, with the aid of a brilliant experiment, that the blue color of the sky is owing to floating particles of invisible dust that break up and scatter the short waves, which are the blue waves, of light. This, as has recently been pointed out, occurs principally at a great elevation, where the atmospheric dust is extremely fine, while in the lower regions of the air, where the dust is coarser, the scattering affects all the rays, or colors, alike. The brilliant fringes of clouds, seen nearly in the direction of the sun, are largely due to dust, which especially accumulates in the neighborhood of clouds, and refracts the sunlight around their edges.

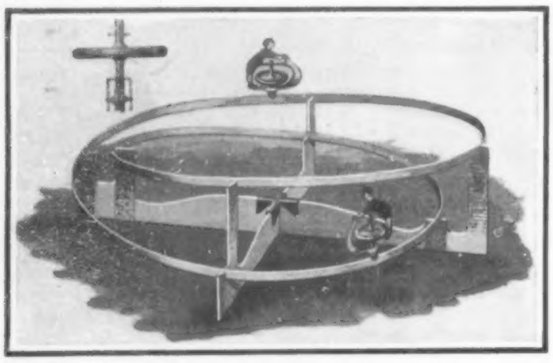
A Correction

THE article on the Unique Wind Vane and Electric Indicator, appearing in our issue of January 21st, 1911, was prepared by Mr. James L. Blackmer, the constructor of the instrument, and not by Mr. Frank C. Perkins.

Curiosities of Science and Invention

A Toy Gyroscopic Monorail

THE mystery of the top, which has in recent years been taken up by the practical technical man, and put to various uses, such as the guiding of torpedoes, the balancing of a car on a monorail, the prevention of the rocking of a vessel in a seaway, etc., is no less attractive to the small boy. However, should he have tired of the common form of scientific top, his inter-



Gyroscopic gymnast on a spiral monorail.

est will no doubt be revived by a recent innovation, hailing from England, which is pictured herewith. This consists of a sort of monorail car of very simple construction, which will travel around a spiral track, or any other form of track provided for it. The familiar gyroscope wheel is mounted in a frame, upon which is the figure of a gymnast. At the bottom of the frame is a roller grooved to fit the spiral track. One flange of the roller, however, is of slightly larger diameter than the other, as shown in the detail view, and on this projecting flange the shaft of the gyroscope wheel bears. Owing to the eccentricity of this contact, the shaft as it rotates serves to drive the roller. Thus a step-down friction gear, in which the reduction of speed is very great, is produced in an exceedingly simple manner. The wheel is revolved at high speed by the usual method of wrapping a string around the shaft and whipping it off quickly. When the roller is placed carefully on the track, the shaft of the gyroscope wheel resting on the larger flange of the roller causes the device to propel itself along the track. The manner in which the figure takes curves and travels steadily uphill or downhill without upsetting is very puzzling and interesting, and makes a very simple demonstration of the principles upon which mono-railroads operate.

Mission Style Observation Car

THE latest departure from old-fashioned ideas in the construction and decoration of railroad cars is shown in the accompanying photograph of a car built in the Mission Style. This is an observation coach which recently made its inaugural run over the "kite-shaped track" of the Santa Fé system in Southern California.

As this country was the scene of the labors of the

A mission style observation car.

Franciscan Fathers, it is quite fitting that travelers should be reminded of these early colonists, not only in the architecture of the homes and public buildings of Southern California, but even in the design of this luxurious observation car. True to the spirit of mission architecture, there is a certain artistic simplicity about the fittings of this coach, which is paneled in pearl gray leather and weathered oak. The revolving easy chair, the parcel racks, and even the lamp brackets and the chandeliers, designed after a mission bell, remind one constantly of the Padrés and their work.

The details of construction do not differ widely from other modern cars except that this one is larger and more costly than the average. It has a length of 76 feet, and weighs 133,000 pounds. It is constructed on a solid steel frame with a center beam of steel running the length of the car underneath, as a reinforcement to prevent telescoping.

Curious Geyser in Florida

ABOUT four or five years ago, in the vicinity of Orlando, Florida, a natural sink, which is some one hundred feet deep and forms a small lake about two hundred yards across, became obstructed, thereby causing about one thousand acres to be flooded.

The numerous lakes which abound in the vicinity of Orlando overflowed into it. Many ways were tried to remove the cause of the obstruction. A diver with dynamite was sent down, and several charges were exploded, but proved of no avail. It was suggested that pipes be driven several hundred feet, to try for an underground passage. This was done, and proved a success.

A curious geyser in Florida.

So the lakes, which number thirteen within the corporation limits of Orlando, are brought to their normal water line. It was soon discovered that for several miles around Orlando these passages existed some four hundred and fifty to five hundred feet below the surface of the ground. The water level at Lake Fairview, some three miles out, became too high for the truck gardens, so a ten-inch pipe was driven about four hundred feet deep. The water in the lake at the present time is about five inches above the pipe, which is driven in the border of the lake. Every six minutes a thirty-five foot gusher is formed and delivered. It is probably caused by air rushing down the pipe with the water and collecting in a natural chamber to a greater pressure than would be produced by the head of water because of the momentum of the flowing water. When the pressure reaches a critical point it stops the flow of water, reverses it, and rushes out with it up the tube.

A Miniature Electric Motor

ONE of the tinest electric motors ever built was recently constructed by M. G. Trevet at Bellevue, France. It works most satisfactorily in spite of its marvelously small dimensions, and has been presented by Carpentier to the French Academy of Sciences.

This motor is a shunt-wound machine with Gramme ring, the dimensions of the inductor being as follows: Height, 0.57 inch; width of base, 0.55 inch; length of shaft, 0.59 inch.

The exciter coil comprises 600 turns of a wire, two ten-thousandths of an inch in thickness. The inductor iron is 0.023 square inch in cross section, and 1.29 inches in average length. The armature, which is 0.24 inch in diameter, comprises twelve teeth. Its windings are subdivided into six sections, and with

Complete electric motor only half an inch high.

288 turns, and yield a useful length of 5½ feet. The commutator comprises six plates kept together by two ivory cones and insulated by six ebonite plates, the whole being secured with an hexagonal nut on a brass tube forced upon the shaft. The leads are connected to minute terminals, the commutator diameter being only 0.1 inch. Each of the brushes consists of two plates kept together by three riveted cross-stays and pressed permanently against the commutator by a ring, screw and spring. A piece of silver—in the place of the carbons used in actual practice—serves to effect the contact. The dimensions of the brushes are as follows: Length, 0.12 inch; width, 0.04 inch; height, 0.03 inch.

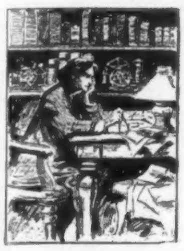
The brush-holders are adjustable, connection with them being made by perforated screws. The steel shaft is 0.03 inch, and the bearings only 0.016 inch in diameter. The motor in full operation uses up 0.2 ampere with a tension of 3.5 volts, viz., an energy of 0.7 watt. Its total weight is but 0.24 ounce avoirdupois.

A Sun Bath in the Snow

WE have frequently heard of Eskimos who have enjoyed divesting themselves of all clothing and taking a sun bath in the snow. Occasionally we hear of white men who claim to enjoy such a bath. Whatever doubts we may have had heretofore have been dispelled by the accompanying photograph, which shows the mountain climber, Paul Reinwald,

Cooling off after a strenuous climb.

cooling off after a strenuous climb up "Old Baldy" in southern California. The photograph was taken by the climber himself on Christmas day in 1909, using an electric circuit and a magnetic release to spring the shutter. The wire may be traced along the snow in the foreground.



The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Automatic Stamp Slitting and Coiling Machine

By Thomas D. Gannaway

FEW people realize the magnitude of the Government's postage stamp industry. It has grown to proportions which the mind finds it difficult to grasp. So great is the demand for postage stamps that a force of several hundred men and women is kept working all the time to make and issue that seemingly insignificant article of public consumption. If you will consider that a sheet of 100 stamps only weighs about as much as two blank sheets of ordinary paper of the same size, and that it takes about 550 tons of paper, about 235 tons of ink, and about 375 tons of gum to make the supply of stamps for one year, you may begin to realize the vastness of the stamp business; and it is constantly growing. The postage stamps were, at one time, all sent from the Bureau of Engraving and Printing—where they are made—to the Post Office Department, and then issued to the various postmasters all over the United States, as ordered by them. As the issues grew rapidly, the task became so great that the officials decided to avoid the unnecessary handling involved in sending the output to the Post Office Department. So it was arranged that the Bureau of Engraving and Printing should issue the stamps directly to the postmasters, and they are now being sent out at the astonishing rate of about eleven billions (all denominations) a year. This is equal to about thirty-one millions a day, which is equivalent to twenty-one thousand a minute, or about three hundred and fifty per second for every second in the year. In this era of progressiveness, when the inventive mind is on the alert in every branch of business, there have been invented a number of machines for affixing postage stamps to letters, so as to save the time and trouble of tearing off, licking, and pasting the stamp of the letter. These machines are very small, measuring only a few inches each way. They cut the stamp loose from the coil, moisten the gummed surface, paste it onto the envelope, and at the same time count the number of stamps used. All the operator has to do is to place the envelope in the machine and then strike the latter with one hand, the machine does the rest. When he has finished stamping letters, he looks at the indicator (or register) to ascertain how many stamps have been spent. For use with this machine (which is of great convenience to private concerns) the stamps must be furnished in strips only one stamp wide and rolled up in a coil. The desire to use these machines created a demand upon the Government to prepare and issue stamps in coils. Mr. J. E. Ralph, Director of the Bureau of Engraving and Printing, wishing to accommodate the public to the fullest extent practicable, undertook to prepare stamps for these machines, sufficient to meet the demand. At first it was not a very difficult task. The stamps are printed in sheets ,twenty stamps square. These sheets were perforated lengthwise and then separated into strips, one stamp wide, and running crosswise of the perforations. A small blank margin is left on each end of the strips and a number of such strips are then fastened together end to end by hand. Then a small reel, somewhat like a fishing reel, is placed between two perpendicular brackets attached to an ordinary office table. Another operator takes the long tape of stamps which is being made by pasting the strips together, and winds them on this reel, until she has five hundred or a thousand stamps, as desired. Until very recently this was the only method known for coiling postage stamps, and, at first, was quite adequate to meet the requirements. But the demand for stamps put up in this form is growing at a remarkable rate. Mr. F. Campbell, who is in charge of this division, tells me it has increased about two hundred per cent in the last year. The increased demand for coiled stamps is the result of the introduction of improved methods for applying stamps, and it is the judgment of Mr. Ralph, the Director, that within a year or two coiled stamps will be universally used by the Post Office Department.

Thirty operators are employed on this work alone. But with the advent of some new automatic separating and coiling machines, invented by Mr. Benjamin Stickney of the Bureau, it is expected that it will soon be possible to fill all orders promptly.

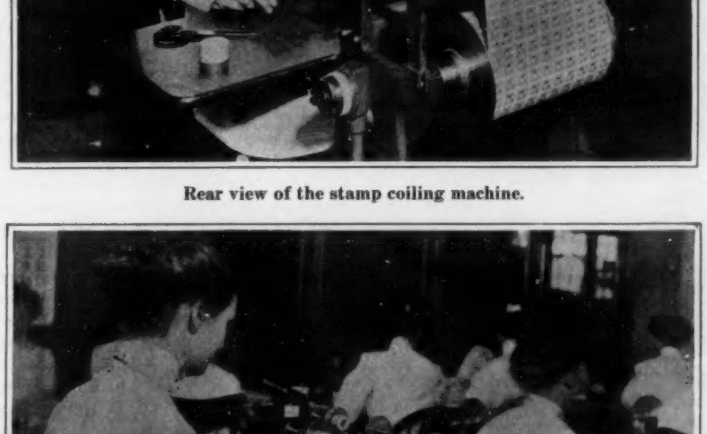
For these machines, the original sheet of two hundred stamps is perforated as before, but instead of being cut into strips, it is cut only once, crosswise of the perforations. This leaves the half sheets ten stamps wide and twenty stamps long. These half sheets must be pasted together endwise before they are fed to the machine. This is done on the long tables shown in our first illustration. Sheets of manila paper of the same width and not quite as long as the half sheets of stamps have ten labels printed on them so as to correspond with the ten rows of stamps, and on the opposite side is a strip of gum running crosswise of the sheet. These sheets are used to make the core on which the stamps are wound and also for wrappers for the individual coils. Before the sheets of stamps are carried to the pasting tables they are arranged according to the size of coils to be made. If coils of five hundred stamps are to be made, a sheet of the manila paper labeled as five hundred is put down as a starting base, then twenty-five sheets of stamps, another sheet of manila paper, then another twenty-five sheets of stamps, and so on, until enough are piled up to fill one of the large spools for the machine. If coils of one thousand stamps each are to be wound, sheets of manila paper labeled as one thousand are used and then fifty sheets of stamps are placed between them.

The operator at the pasting table takes the sheet of manila paper off of the top of the stack of stamps and places it to her left, i. e., between the spool and the aluminium bar which extends across the center of her table. She then takes the first sheet of stamps with her right hand and slips it under this aluminium bar so that the end of the sheet is even with the opposite edge of the bar. The next step is to attach the sheet of stamps to the manila paper. In a slot under the aluminium bar is a small cylindrical tank about two inches in diameter and five inches long. This is fitted with a small spongelike flat wick one-fourth of an inch thick and one inch wide. The tank is filled with water and then closed, and the wick, which is fitted in it like an ordinary lamp wick, extends up far enough to touch the bottom of the aluminium bar. The operator then—while holding the stamps in place with her right hand—takes hold of this tank with her left and pulls it across the table toward her and then pushes it back. The wick thus moistens a strip of the gum all the way across the end of the sheet. This is then slipped through and pasted onto the sheet of manila paper. The next sheet of stamps is taken and treated the same way and then pasted onto the one which has just passed through. As this is done they are wound on the large spool at the end of the table. When this spool is filled it is ready for the automatic coiler.

As will be seen by the accompanying cuts, this machine is very compact, but it is capable of doing a large amount of work. One of the large spools from the pasting tables is put into the machine, as shown in our illustrations. The last sheet put on the spool is manila paper and this is started through the machine —which is equipped with nine rotary knives—and is cut into strips of the same width as the strip of stamps. The machine has ten spindles, each carrying a

The pasting table.

Rear view of the stamp coiling machine.



Front view of stamp coiling machine.

AUTOMATIC STAMP SLITTING AND COILING MACHINE

small reel flanged on one side (see our second illustration). On these reels the stamps are wound. The end of the reels are split, and each is fitted with a ratchet, so that anyone of them can be turned by hand without moving the spindle. The machine is threaded, as it were, by taking the ends of the manila paper which has been started through, and putting one of them in the split end of each reel and turning it until the strip of paper is straight. This makes the cores for the first coils of stamps. The machine is then started (the motive power being electricity) and almost before you have had time to realize what is happening, the second sheet of manila paper is seen passing through, indicating that the ten coils have been completed. The machine is then stopped and with a pair of scissors the strips of paper are severed, leaving a certain length of gummed strip extending from each coil. This is wound up by hand and pasted down, thus making a wrapper for the coil. After the coils have all been removed from the machine, the ends of paper left in it are threaded up as before, thus making the cores for the next ten coils.

At present the Government has only one of these machines and three pasting tables, but more are being built. The four operators which it takes to handle these, are coiling as many stamps as twenty-two workers could make by hand; thus saving $12,000 to $15,000 per year to the Government.

The machine has a capacity of twelve hundred coils of five hundred stamps each in seven hours. The cost of installation including the three pasting tables is less than $1,000; therefore it will save several times its cost in one year.

The New Trade-Mark and Patent Treaties

THE United States Senate on February 8th, 1911, approved the conventions adopted by the Fourth International Congress of American States at Buenos Aires and signed August 20th, 1910, relating to the protection of trade-marks and patents. These conventions which were prepared by the United States delegation, for which the Commissioner of Patents, Mr. Edward B. Moore, was the expert *attaché*, were adopted, after a most thorough and exhaustive consideration, during the closing session of the Congress. Their adoption was of course subject to ratification by the various governments, and the United States Senate Committee on Foreign Relations has had them under consideration for several months, but the treaties were not made public until the 8th instant.

The following are the more important articles on trade-marks:

Article II.—Any mark duly registered in one of the signatory States shall be considered as registered also in the other States of the Union, without prejudice to the rights of third persons and to the provisions of the laws of each State governing the same.

Article III.—The deposit of a trademark in one of the signatory States produces in favor of the depositor a right of priority for the period of six months, so as to enable the depositor to make the deposit in the other States.

Article VI.—All questions which may arise regarding the priority of the deposit or the adoption of a trade-mark shall be decided with due regard to the date of the deposit in the State in which the first application was made therefor.

Article VII.—The ownership of a trademark includes the right to enjoy the benefits thereof and the right of assignment or transfer in whole or in part of its ownership or its use in accordance with the provisions of the laws of the respective States.

Article VIII.—The falsification, imitation, or unauthorized use of a trade-mark, as also the false representation as to the origin of a product, shall be prosecuted by the interested party in accordance with the laws of the State wherein the offense is committed.

Article IX.—Any person in any of the signatory States shall have the right to petition and obtain in any of the States, through its competent judicial authority, the annulment of the registration of a trade-mark, when he shall have made application for the registration of that mark, or of any other mark, calculated to be confused, in such State, with the mark in whose annulment he is interested, upon proving:

(*a*) That the mark the registration whereof he solicits has been employed or used within the country prior to the employment or use of the mark registered by the person registering it or by the persons from whom he has derived title;

(*b*) That the registrant had knowledge of the ownership, employment, or use in any of the signatory States of the mark of the applicant, the annulment whereof is sought, prior to the use of the registered mark by the registrant or by those from whom he has derived title;

(*c*) That the registrant had no right to the ownership, employment, or use of the registered mark on the date of its deposit;

(*d*) That the registered mark had not been used or employed by the registrant or by his assigns within the term fixed by the laws of the State in which the registration shall have been made.

Article X.—Commercial names shall be protected in all the States of the Union, without deposit or registration, whether the same form part of a trade-mark or not.

Article XI.—For the purposes indicated in the present convention a Union of American Nations is hereby constituted, which shall act through two international bureaus established one in the city of Havana, Cuba, and the other in the city of Rio de Janeiro, Brazil, acting in complete accord with each other.

Article XII.—The international bureaus shall have the following duties:

1. To keep a register of the certificates of ownership of trade-marks issued by any of the signatory States.

2. To collect such reports and data as relate to the protection of intellectual and industrial property and to publish and circulate them among the nations of the Union, as well as to furnish them whatever special information they may need upon this subject.

3. To encourage the study and publicity of the questions relating to the protection of intellectual and industrial property; to publish for this purpose one or more official reviews, containing the full texts or digest of all documents forwarded to the bureaus by the authorities of the signatory States.

The governments of said States shall send to the International American Bureaus their official publications which contain the announcements of the registrations of trade-marks, and commercial names, and the grants of patents and privileges as well as the judgments rendered by the respective courts concerning the invalidity of trade-marks and patents.

4. To communicate to the governments of the Union any difficulties or obstacles that may oppose or delay the effective application of this convention.

5. To aid the governments of the signatory States in the preparations of international conferences for the study of legislation concerning industrial property, and to secure such alterations as it may be proper to propose in the regulations of the Union, or in treaties in force to protect industrial property. In case such conferences take place, the directors of the bureaus shall have the right to attend the meetings and there to express their opinions, but not to vote.

6. To present to the governments of Cuba and of the United States of Brazil, respectively, yearly reports of their labors which shall be communicated at the same time to all the governments of the other States of the Union.

7. To initiate and establish relations with similar bureaus and with the scientific and industrial associations and institutions for the exchange of publications, information, and data conducive to the progress of the protection of industrial property.

8. To investigate cases where trademarks, designs, and industrial models have failed to obtain the recognition of registration provided for by this convention, on the part of the authorities of any one of the States forming the union, and to communicate the facts and reasons to the government of the country of origin and to interested parties.

9. To co-operate as agents for each one of the governments of the signatory States before the respective authorities for the better performance of any act tending to promote or accomplish the ends of this convention.

Article XIII.—The bureau established in the city of Havana, Cuba, shall have charge of the registration of trade-marks coming from the United States of America, Mexico, Cuba, Haiti, the Dominican Republic, El Salvador, Honduras, Nicaragua, Costa Rica, Guatemala, and Panama.

The bureau established in the city of Rio de Janeiro shall have charge of the registration of trade-marks coming from Brazil, Uruguay, the Argentine Republic, Paraguay, Bolivia, Chili, Peru, Ecuador, Venezuela, and Colombia.

Article XIV.—The two international bureaus shall be considered as one, and for the purpose of the unification of the registrations it is provided:

(*a*) Both shall have the same books and the same accounts kept under an identical system.

(*b*) Copies shall be reciprocally transmitted weekly from one to the other of all applications, registrations, communications, and other documents affecting the recognition of the rights of owners of trade-marks.

Article XVI.—The governments of the Republic of Cuba and of the United States of Brazil shall proceed with the organization of the Bureaus of the International Union as herein provided, upon the ratification of this convention by at least two-thirds of the nations belonging to each group.

The simultaneous establishment of both bureaus shall not be necessary; one only may be established if there be the number of adherent governments provided for above.

Article XVII.—The treaties on trademarks previously concluded by and between the signatory States, shall be substituted by the present convention from the date of its ratification, as far as the relations between the signatory States are concerned.

Article XVIII.—The ratification or adhesion of the American States to the present convention shall be communicated to the Government of the Argentine Republic, which shall lay them before the other States of the Union. These communications shall take the place of an exchange of ratifications.

The following are the more important articles on patents:

Article II.—Any persons who shall obtain a patent of invention in any of the signatory States shall enjoy in each of the other States all the advantages which the laws relative to patents of invention, designs, and industrial models concede. Consequently, they shall have the right to the same protection and identical legal remedies against any attack upon their rights, provided they comply with the laws of each State.

Article III.—Any person who shall have regularly deposited an application for a patent of invention or design or industrial model in one of the contracting States shall enjoy, for the purposes of making the deposit in the other States and under the reserve of the rights of third parties, a right of priority during a period of twelve months for patents of invention, and of four months for designs or industrial models.

In consequence the deposits subsequently made in any other of the signatory States before the expiration of these periods can not be invalidated by acts performed in the interval, especially by other deposits, by the publication of the invention or its working, or by the sale of copies of the design or model.

Article IV.—When, within the terms fixed, a person shall have filed applications in several States for the patent of the same invention, the rights resulting from patents thus applied for shall be independent of each other.

They shall also be independent of the rights arising under patents obtained for the same invention in countries not parties to this convention.

Article V.—Questions which may arise regarding the priority of patents of invention shall be decided with regard to the date of the application for the respective patents in the countries in which they are granted.

Article VI.—The following shall be considered as inventions: A new manner of manufacturing industrial products, a new machine or mechanical or manual apparatus which serves for the manufacture of said products, the discovery of a new industrial product, the application of known methods for the purpose of securing better results, and every new, original, and ornamental design or model for an article of manufacture.

The foregoing shall be understood without prejudice to the laws of each State.

Article VII.—Any of the signatory States may refuse to recognize patents for any of the following causes:

(*a*) Because the inventions or discoveries may have been published in any country prior to the date of the invention by the applicant.

(*b*) Because the inventions have been registered, published, or described in any country more than one year prior to the date of the application in the country in which the patent is sought.

(*c*) Because the inventions have been in public use, or have been on sale in the country in which the patent has been applied for, one year prior to the date of said application.

(*d*) Because the inventions or discoveries are in some manner contrary to morals or laws.

Article VIII.—The ownership of a patent of invention comprises the right to enjoy the benefits thereof, and the right to assign or transfer it in accordance with the laws of the country.

Article IX.—Persons who incur civil or criminal liabilities, because of injuries or damage to the rights of inventors, shall be prosecuted and punished in accordance with the laws of the countries wherein the offense has been committed or the damage occasioned.

Article X.—Copies of patents certified in the country of origin, according to the national law thereof, shall be given full faith and credit as evidence of the right of priority, except as stated in Article VII.

Article XI.—The treaties relating to patents of invention, designs, or industrial models, previously entered into between the countries subscribing to the present convention, shall be superseded by the same from the time of its ratification in so far as the relations between the signatory States are concerned.

Validity of Recent Patents.—Out of eight adjudicated patents, one of which was a reissue, reported in the Patent Office Official Gazette of January 31st, 1911, five patents were sustained, two patents were held void and the reissue was held void as not being for the same invention as the original patent. One of the sustained patents was held infringed and four of the said patents were held not infringed.

Legal Notes

Successive Patent Appeals. —A novel case is found in Avery against Case, 174 Federal Reporter, 147. One Holsclaw, an inventor of an improvement, had made application to the Patent Office for a patent. Before his patent issued another inventor, Sobey, interfered by applying for a patent on a like subject-matter. The Examiner of Interferences determined in favor of Holsclaw, upon the disclosure in the Sobey application that the invention had not been conceived by him until after the filing of the Holsclaw application. Thereupon Sobey, to delay a final issuance of the Holsclaw patent, moved for a vacation of the Examiner's judgment; which being denied, he appealed to the Examiner in Chief; which being denied, he appealed to the Commissioner of Patents; which being denied, he moved for a rehearing before the Commissioner; which being denied, he appealed to the District Court of the District of Columbia; which being denied, he petitioned for a rehearing in the Court of Appeals of the District of Columbia; which being denied, he presented a petition to the Supreme Court of the United States for a writ of certiorari; which being denied, further dilatory steps were taken in the Court of Appeals and before the Commissioner of Patents. This case is brought for damages in delaying the issuance of the Holsclaw patent. The court held that the complaint did not state a cause of action for the recovery of damages, because specific damages were not alleged, and the case, if maintainable at all, was one in the nature of trespass on the case for injury and damage to plaintiff, and the mere postponement of the term of its monopoly was not necessarily to its detriment.

Brief Notes Concerning Inventions

A Remarkable Coincidence.—A patent attorney whose firm has Washington offices, vouches for the absolute truth of the following story of a remarkable series of coincidences in connection with two applications for patent. The attorney had two clients of the same name. For the sake of the story, we will assume that the name was Linwood. One Linwood lived in Washington and the other in Chicago, and both were personally known to the attorney. The two Linwoods, although not related, resembled each other personally, both physically and temperamentally. They had applications for patent pending at the same time for different inventions and both the applications were placed in interference, the party interfering with the Washington Linwood living in Chicago, and the party interfering with the Chicago Linwood living in New York. In neither interference was testimony taken. In both interferences the cases were settled by the agreement of the parties, the agreement in each case being that one of the parties should take the right to use the invention for a restricted purpose and the party taking the right for the restricted purpose in each case was Linwood.

New Flour Milling Patents. —Two United States patents were issued February 7th, 1907, to a resident of Weybridge, England, for processes of milling flour which are thought by some to be of much importance in the milling art. Both patents relate to the addition of water to flour by subjecting the stock or flour to the action of a spray of water. One of the patents is for a process in which the stock is passed through a set of rolls, then subjected as it comes from the rolls to a spray of water and is then passed while still moist through another set of rolls. It is claimed that by the improvement the water becomes very intimately mixed with the flour during the finishing milling operations and the color of the flour is improved. The other patent is similar in character, but provides for the addition of "modifying ingredients."

RECENTLY PATENTED INVENTIONS.

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

The weekly Index of Patents issued by the United States Patent Office will be found in the Scientific American Supplement.

Pertaining to Apparel.

WALL RACK.—M. LOWENSTEIN, Malden, Mass. This invention provides a rack for hanging coats, having combined therewith a box receptacle for a hat, and hanging devices for canes and umbrellas, and brushes for use for both coat and hat; provides a hat receptacle to be used in an elevated position; and provides means for opening and closing the lid of the hat receptacle.

Of General Interest.

DENTAL MATRIX CLIP.—G. H. SHANNON, Cambridge, N. Y. The improvement provides a molding ring for retaining the molding material used in obtaining a cast impression of a tooth cavity, or a plastic filling material, from spreading under the gum and to adjacent teeth; provides a clamp for retaining the ring in operative position; and provides a fastening device for the clamp, which will allow of the bite or occlusion of the upper and lower dentures to be taken while the apparatus is in position and without disturbing the same.

BURIAL VAULT.—J. BERMEL, New York, N. Y. This invention relates to a subterranean grave vault, which is adapted to receive one or more bodies and protect them from vermin and seepage. It provides a vault with an upstanding flange or ridge arranged around the opening, whereby any surface waters are prevented from flowing into the interior of the vault.

TORPEDO OR BOMB.—W. J. TURNBULL, New Orleans, La. In this patent the invention is an improvement in torpedoes, shells, bombs, or the like designed for use in blowing up vessels or other objects; and the invention has for its purpose to provide a novel construction which may be attached to the object to be blown up and subsequently exploded.

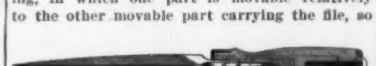
OXYGEN GENERATOR.—R. C. BRADLEY, Shreveport, La. An object in this case is to provide a portable generator which will automatically generate gas as fast as it is consumed, and in proportion to consumption of the gas. A further object is to provide a device which can be used with a cartridge for generating the gas or with an auxiliary device for generating the gas by means of heat.

PROCESS FOR THE MANUFACTURE OF SOLUBLE SOLVENTS.—G. NAUTON, G. DE MARSAC, H. NAUTON, St.-Ouen, Seine, and T. F. TESSE, Paris, France. The present invention relates to new products derived from alkali sulfonates of certain oils and chlorinated hydrocarbons of the ethane and ethylene series and their process of manufacture. These products possess over the solvents already known and employed, the advantage of absolute solubility in water and a stability which permits of their use in industry for the most varied purposes.

PORTABLE NAIL AND SCREW HOLDING CABINET.—F. A. BILLSTONE, Findlay, Ohio. This invention provides a cabinet wherein the pockets are readily varied in their capacity; provides for assembling the structure rapidly and readily; provides means for collapsing the structure to facilitate the packing or trans-shipment of the same; provides a construction for the pockets wherein is avoided edges which may rasp the skin of the person extracting articles from the pockets and which may prevent the extraction of the articles. The cabinet may be constructed from sheet metal.

Hardware and Tools.

FILE HANDLE.—WILLIAM B. WANKEL, 557 Warren Street, Brooklyn, N. Y. The more particular purpose in this invention is to provide a type of handle as shown in the engraving, in which one part is movable relatively to the other movable part carrying the file, so



FILE HANDLE.

that the latter can turn independently of the handle. It relates to the provision of a tubular member revolubly mounted in the handle and adapted to hold a piece of comparatively soft material, such as wood, into which the file shank is driven and thus held rigid in relation to the tubular member.

HOSE COUPLING.—J. E. W. BOESCH, Columbia, Nev. The object here is to provide a coupling which may be quickly connected and disconnected, by pulling the sections straight away from each other, thus avoiding the disadvantages of twisting the hose, and wherein an efficient lock is provided for preventing accidental disengagements.

Household Utilities.

VENTILATING CONDUIT FOR GARBAGE CLOSETS. — CORNELIA S. ROBINSON, New York, N. Y. The object in this instance is to provide a closet with a ventilating conduit having at its outer terminal a device for keeping out the rain, while permitting a free circulation of air through the conduit, the said device being so constructed that it may be placed in the wall of a building with either of its closed longitudinal faces uppermost with equally good results, so that the mechanic in installing the device, however careless he may be, will be certain to make a proper connection between openings of the receptacle and the atmosphere beyond the conduit.

CONVERTIBLE CHAIR.—A. REISMAN, New York, N. Y. The more particular purpose in this invention is to provide a chair frame with rockers which may be swung into two different normal positions, so that the chair as a whole may be used as a rocking chair or as an ordinary chair, the device being provided with a seat movable into either of two normal positions according to the form assumed by the chair.

Machines and Mechanical Devices.

DREDGE.—W. T. SAIN, Seattle, Wash. Mr. Sain's improvement pertains particularly to devices connected with the carriage for temporarily locking it automatically at one end of the track, and for releasing it automatically when the bucket is raised; also to means connected with the carriage for supporting the bucket while dumping, and traveling back on the track.

CENTRIFUGAL PUMP.—J. L. HEALD, Alamogordo, New Mex. For pumping purposes, use is made of a casing provided with a peripheral chamber, a rotor mounted to turn in a casing, deflecting wings on the rotor, and blades or valves mounted to turn with the rotor and adapted to guide the flow of water or liquid to be pumped. The pump is adapted to operate in either of two directions.

SHOE POLISHING MACHINE. — E. F. HECKER, New York, N. Y. In the present patent the object of the inventor is to provide an efficient machine for polishing boots and shoes, in which the polishing brushes, cloths, or buffers are actuated by suitable mechanism which in turn is operated through the movement of the foot support under the imposed weight and downward pressure of the foot.

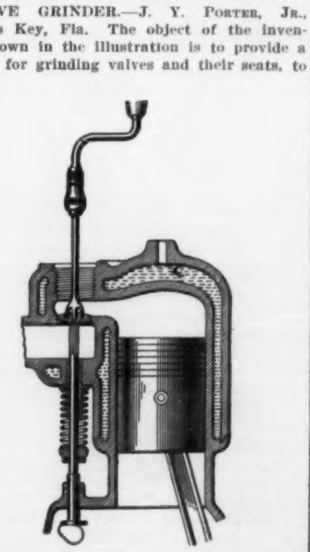
TRAVELING CONVEYER.—R. M. CLARK, Webb City, Mo. This machine removes tailings when piled upon the ground, or sand, etc., the same being taken up by a conveyer properly formed of belts with buckets attached, and by which the material is delivered into a chute and discharged into a car. Operative parts, save the car, are mounted upon a wheel-truck adapted like the car to run on rails. Truck wheels are geared with the same motor that drives the conveyer proper, gearing for the wheels being reversible, so that the machine may be driven forward or back. The car may be run up to, or moved away from the conveyer proper, as conditions require.

WATER PURIFIER FOR ICE MACHINES. —J. J. SCHRADE, Waco, Texas. This machine is adapted for the purification of water for artificial ice making, but is adapted also for the purification of water for any purpose. There is but little waste of water in this system, none in fact except when the filter is cleaned.

INDICATING DEVICE.—C. N. WISNER, Memphis, Tenn. An object in this invention is to provide a device which may be manipulated by an operator at a central station so as to display visible signs for indicating values and locations, thereby dispensing with the necessity of the customary ticker now used in most brokers' offices.

Prime Movers and Their Accessories.

VALVE GRINDER.—J. Y. PORTER, JR., Knights Key, Fla. The object of the invention shown in the illustration is to provide a grinder for grinding valves and their seats, to



VALVE GRINDER.

secure a perfect fit between the valve and its seat. For this purpose use is made of a shank having depending prongs, one of the latter being longer than the others, and a valve having holes therein, one of the holes being deeper than the others, the prongs being adapted to engage the holes in the valve, so that the longer prong depends to the bottom of the deeper hole and the remaining prongs extend a distance into the remaining holes.

ROTARY ENGINE.—F. P. NICHOLS, Houston, Texas. The invention relates more particularly to that type of rotary engine, one example of which is illustrated in a previous patent granted to Mr. Nichols. An object of his present invention is to more effectually control the delivery of motive fluid to the pockets in the outer casing, and in order to do this, he provides the sliding blades or pistons with valves, which are mechanically operated during the movement of the rotor.

VARIABLE HORSE-POWER GAS ENGINE.—A. M. LEONI, Highland, N. Y. The object in this case is to produce a gas or explosive engine which may be arranged in such a way that the horse-power may be made to vary between wide limits. In other words, the engine is constructed in such a way that its horse power can be regulated not only by regulating the amount of explosion charge, but also by regulating the explosion chamber itself.

Railways and Their Accessories.

RAIL JOINT.—J. M. JORGENSEN, New York, N. Y. The invention pertains to rail joints, the more particular purpose being to provide at the junction between consecutive rails a pair of fish plates so shaped, proportioned and arranged, as to compensate for wear of the plates and of the rails, in such manner that by tightening the plates relative to the rails, the latter can be periodically braced up and rendered as if new.

STOCK GUARD.—S. P. FOSTER and H. V. STEVENS, East Chattanooga, Tenn. The intention in this case is to provide a stock guard for railways and the like, to prevent animals from walking along the tracks and being struck by trains. For the purpose mentioned, use is made of a platform having spaced members and pivotally mounted on a tie, and a picket barrier mounted to swing outwardly on the platform when one end of the same is moved downwardly.

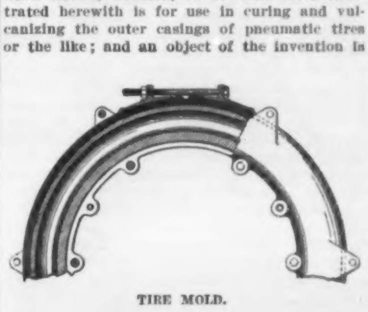
EMERGENCY SLIDE VALVE ACTUATOR FOR LOCOMOTIVES.—F. P. SARAMAN, Pittston, Pa. It is a common occurrence for the piston stem of the valve yoke of one or both of the steam slide valves of a locomotive to break while *en route*, necessitating long delays incident to sending a messenger on foot to the nearest station to telegraph for another engine, or in disconnecting the broken valve and running the engine on one side until a point is reached where another locomotive is to be had. This invention overcomes such delays.

Pertaining to Recreation.

PLEASURE RAILWAY.—J. W. BOURKE, Dorchester, Mass. The invention pertains to an amusement device of the pleasure-railway type, in which the pleasure-seekers are given a rolling, jolting ride in a zig-zag dipping manner calculated to give all the excitement required. The device is simple in construction, and both exciting and fascinating in operation.

Pertaining to Vehicles.

TIRE MOLD.—JOSEPH W. THROPP, East State Street, Trenton, N. J. The mold illustrated herewith is for use in curing and vulcanizing the outer casings of pneumatic tires or the like; and an object of the invention is



TIRE MOLD.

to provide a device which will permit a hard cure of the tire casing at the tread, where there is the greatest amount of wear, and which will permit a soft cure at the sides of the casing, where flexibility is necessary. The device is intended to be efficient in operation and easily manipulated.

STATION INDICATOR.—B. KENDE, New York, N. Y. This indicator is for use on passenger vehicles, to inform passengers as to the name of the next succeeding place or station at which the vehicle will stop. It is especially adaptable for use on cars and is of a form particularly designed to be secured in position transversely of the car adjacent the ceiling thereof, whereby the information imparted by the indicator may be readily seen by persons at either end of the car.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

BRAYLEY'S ARRANGEMENT OF FINGER PRINTS IDENTIFICATION AND THEIR USES. By Frederick A. Brayley. Boston: The Worcester Press, 1910. 12mo.; 118 pp. Price, $2.

The wonderful possibilities of finger print "signatures" have long been recognized by foreign criminal departments, and the system is now adopted by police, secret service, United states army and navy; and banks, insurance companies, bond companies, secret societies, and all lines of business, where a perfect system of identification is necessary, are considering this system with a view to adopting it. This exhaustive treatise was prepared, under the supervision of an expert, from data supplied by Mr. Henry Richardson, the head of the Massachusetts Bureau of Criminal Identification. This system of classification is in conformity with that in use by the British government central offices, United States government, and the various police departments of the United States; it contains original and valuable data for filing finger prints.

BUCH BERUEHMTER INGENIEURE. By Dr. Richard Hennig. Leipzig: Otto Spamer, 1911. 308 pp.; 43 illustrations.

Ten biographies of distinguished engineers are included in the volume before us. The men discussed are William Siemens, James Buchanan Eads, John Ericsson, Ferdinand de Lesseps, Alfred Nobel, Sir Henry Bessemer, John Fowler, Nicolaus Riggenbach, Otto Jutze, and Max von Euth. The biographies in the main seem well written, and may be regarded as giving accurate details of the lives of the men discussed. One wonders, however, why so eminent an engineer as Sir Benjamin Baker is referred to as "ein gewisser Benjamin Baker," for surely Sir Benjamin Baker's part in the erection of the great Forth bridge was as great as that of Sir John Fowler. Also why Brunel, who was probably the greatest English engineer that ever lived, is not made the subject of one of the biographies.

WHITE PAINTS AND PAINTING MATERIALS. By W. G. Scott, C. E. Chicago: The Modern Painter, 1910. 8vo.; 493 pp.

The plan on which this book is built commends itself favorably to the reviewer. The first section deals with "the physical test of paint." Then are considered in order the several kinds of white paints, classified according to their bases: lime, magnesia, barium, alumina, silica, zinc, lead and organic materials. Incidentally products not strictly falling under the heading of paints are dealt with, such as putty and various kinds of pastes. A concise account is given of the sources of raw materials, the manufacturing processes, and the methods of analysis of interest in connection with the several paints and other materials treated. A very useful set of tables is appended. There is a good index, but we miss a synopsis of the chapter-contents. A definition which occurs in a footnote of the "Table of Elements" seems to require revision. We read there: "The melting point of a gas is supposed to be the temperature at which the *liquid-gas* begins to assume the gaseous form." The wording of this appears to us unfortunate. But this is a mere oversight in what seems to be an excellent book.

AN INTRODUCTION TO ZOOLOGY. By Robert W. Hegner, Ph.D. New York: The Macmillan Company, 1910. 350 pp.; 161 illustrations. Price, $1.90 net.

The text book before us has been designed to cover the field of the introductory course in zoology which is now given at several of the leading universities, courses dealing with invertebrate types only, and followed by a course on vertebrate types during the second half year. This explains some of the omissions which are to be found in works of this character, and why only a few animals belonging to the very important phyla, as viewed from an evolutionary standpoint, are considered. These few types, however, are intensively studied in an endeavor to teach the fundamental principles of zoology in a way that is not possible without a superficial examination of types from all the phyla. Morphology, instead of being especially emphasized, is co-ordinated with physiology, ecology, and behavior, thus serving to illustrate by a comparative study, the probable course of evolution. The animals are treated not as inert objects for dissection, but as living organisms whose activities are of fundamental importance. An excellent glossary has been included which ought to prevent the confusion which students usually encounter when suddenly confronted with a number of scientific terms.

INSECTS AND DISEASE. By Rennie W. Doane, A.B. New York: Henry Holt & Co., 1910. 227 pp.; 110 illustrations. Price, $1.50 net.

The subject of preventive medicine is one that is attracting world-wide attention to-day, so much so that there is hardly a single periodical of the day that has not at some time discussed one phase of the subject. In the little book before us, an excellent attempt has been made to bring together and place in untechnical form the most important of the facts which have been presented in technical magazines or special papers. The intimate biological relations of the animals and parasites discussed is pointed out in clear articles. The contents of the book are: Chapter I, Parasitism and Disease; Chapter II, Bacteria and Protozoa; Chapter III, Ticks and Mites; Chapter IV, How Insects Cause or Carry Disease; Chapter V, House-flies or Typhoid-flies; Chapter VI, Mosquitoes; Chapter VII, Mosquitoes and Malaria; Chapter VIII, Mosquitoes and Yellow Fever; Chapter IX, Fleas and Plague; Chapter X, Other Diseases, Mostly Tropical, Known or Thought to be Transmitted by Insects.

AN INTRODUCTION TO THERMODYNAMICS. By John Mills. New York: Ginn & Co., 1910. 136 pp. List price, $2.

The subject treated in this book is one which requires perhaps more than others a scrupulous care and attention to details of reasoning on the part of the teacher and the student. It is difficult to give full attention to all fundamental points in a book which in a small compass is intended not only to set forth the principles of thermo-dynamics, but at the same time to give a somewhat detailed introduction to the application of this branch of theoretical physics to engineering problems. To the engineering student, however, who as a rule may not find time to devote to a more extended study of the thermo-dynamics, this book should offer valuable assistance. Of the five chapters into which it is divided, the first deals with "Fundamental Concepts and Laws"; the second is devoted to the study of the thermo-dynamics of "Gases," and includes a consideration of some of the principal types of gas-engine cycles. Chapter III is headed "Water and Saturated Vapor," the fourth chapter deals with "Superheated Steam," and the last, devoted to "Flow of Steam and Gases," will serve as a fitting introduction to the more detailed study of the turbine engine. Numerous examples are scattered through the book, and should prove a very valuable feature. Tables of constants relating to gases, water and steam, and a table of five-figure logarithms are appended at the end of the volume.

THE PRINCIPLES OF HYGIENE. By D. H. Bergey, A.M., M.D. Third edition. Philadelphia and London: W. B. Saunders Company, 1910. 8vo.; 555 pp. Price, $3.

This work is in its third edition and requires no introduction. Its general excellency has been preserved, and certain sections dealing with subjects in which marked progress has been made of recent years have been brought up to date.

The book devotes separate chapters to such topics as: Air; Ventilation; Water; Sewage Disposal; Food and Diet; Clothing; Industrial Hygiene; School Hygiene; Hygiene in Army and Navy; Disinfection; and so forth. Both the treatment and arrangement of the subject is excellent, and the book should find a sphere of the greatest utility, not only as a manual for the student, but also in the enlightened home and in the hands of men in various callings who may have occasion to consult a work on hygiene.

The statement is made on page 6 that about five per cent of the oxygen contained in the air inhaled by the lungs is absorbed. This of course is an error of expression. The oxygen absorbed amounts to five per cent of the volume of air inhaled. As an example accompanies this statement, and the relations are correctly set forth in the example, this error is perhaps not likely to cause serious misapprehension.

A MANUAL OF PERSONAL HYGIENE. By American Authors. Edited by Walter L. Pyle, A.M., M.D. Fourth edition. Philadelphia and London: W. B. Saunders Company, 1910. 471 pp.; small 8vo.

The fourth edition of this very admirable book retains all the virtues of the earlier issues, and is improved by the addition of a number of new features, including a section on "The Body Posture." In the section on "Physical Exercise" there has been introduced an illustrated presentation of a system of home gymnastics. Another very important addition is a chapter by D. H. Bergey, M.D., on "Domestic Hygiene." For the benefit of those who are not familiar with the earlier editions of this work, it may be well to briefly indicate its scope as brought out in the chapter headings. The arrangement of the first six chapters is laid down along anatomical lines. They are devoted severally to the digestive organs, the skin, the respiratory system, the ear, the eye, and the nervous system. The remaining chapters, dealing with "physical exercise," "body posture," and "domestic hygiene," have already been referred to. The appendix which concludes the volume contains valuable hints relating to the care of the sick and the measures to be adopted in accidents and emergencies. Some book of this kind should be in every home, and the volume before us commends itself particularly for its conciseness, clearness, scientific accuracy, and scholarly worth.

MEMOIRS OF THE UNIVERSITY OF CALIFORNIA. Volume 2. The Silva of California. By Willis Linn Jepson. Pages 1-480, plates 1-85, maps 1-3. Berkeley, California; University of California Press, 1910. Price, $9.

Material for the preparation of this volume is the result of field studies and collections made by the author in nearly all parts of California during the last nineteen years. In making collections, the object has been not only to gather representative material, but as extensive a series of variations as possible. Extremes of variations on a single individual have also been looked for and incorporated in the volume, a practice which has been of the greatest service in determining the limits of species and in locating dubious material. Still another object has been to pursue the study of trees in forest areas least affected by our industrial civilization, and therefore, to push explorations into the remoter parts of the State, beyond frontier settlements, along mountain trails, or through the virgin forest itself.

Since the time of Vancouver, botanical knowledge of the native trees of California has been discussed in formal and rather short diagnoses of the species with a general indication of range, although there have been occasional and valuable studies on the embryology and histology of a few species. Mr. Jepson has performed a notable work in bringing together in one volume an account of the trees of California which represents with high accuracy our present knowledge of their taxanomy and geographical distribution.

GROSSE MÄNNER. By Wilhelm Ostwald. Third and fourth editions. Leipzig: Akademische Verlagsgesellschaft, 1910.

These biographical studies may be regarded as a by-product of Ostwald's scientific labors, but a by-product which has assumed the dignity of a task of prime importance. The papers of which the volume is composed have all been inspired by the one thought that the distinguished men of a nation, the men who have contributed greatly to the progress of the world, and, above all, to scientific progress, are not to be regarded simply as sports of nature, but that they may ultimately become the products of a process of conscious development. To be sure, Ostwald does not maintain that the psycho-physical conditions which cause a boy to develop into a great man are the subject of voluntary creation, but he does maintain that there are far more potentially great men born than are ever permitted to assert themselves. If, therefore, the biology of the species were more exactly known, Ostwald believes that it would be possible to eliminate those injurious influences which prove the destruction of many a possible genius. Naturally, our system of education must be first reformed, and it is in the school that Ostwald would first begin to apply his system. The men whom Ostwald critically considers in the light of his theory are Sir Humphry Davy, Julius Robert Meyer, Michael Faraday, Justus Liebig, Charles Gerhardt, and Herman Helmholtz. Each one of these great men of science is discussed pretty much on the same plan. In almost every case, the scientist's ancestry is inquired into, his early education and the influence of his school surroundings examined, his natural bent of mind indicated, and the manner in which his native gifts were fostered or retarded.

HANDBUCH FUER HEER UND FLOTTE. Encyclopedia of Military Art and Allied Sciences. Edited by Lieut. Gen. Georg von Alten, in collaboration with numerous officers. Containing numerous printed and colored plates, charts, plans, and figures in the text. Berlin: Deutsches Verlagshaus Bong & Co.

The new instalments of the Handbuch für Heer und Flotte begin with "Dsungarei" and end with "Fernsprechwesen." Among the more notable articles may be mentioned those on "Dunkirk," "Dueppel," "Albrecht Duerer," "Ehrengericht," "Einheitsgeschoss," "Eisen," "Eisenbahn," "Elba," "England," "Englische Pferdezucht," "Europa," and "Feldgeschuetz." The thirtieth instalment has some excellent color plates, illustrating the flags of various periods.

HAZELL'S ANNUAL, 1911. London: Hazell, Watson & Viney, Ltd., 1911.

The twenty-seventh volume of Hazell's Annual is a remarkable record of the men and movements of the time. Here are not only biographical details of the members of the new House of Commons, with the figures of the pollings at the General Election, but articles bringing up to date the development of the Constitutional Crisis and the pronouncements of party leaders on the Referendum, Home Rule, the Osborne Judgment, Woman Suffrage, and all the other political topics of the hour. Colonial and Foreign affairs, as usual, are fully dealt with, and there are valuable articles on the international disputes of the past year, Imperial Defense, the Declaration of London, and other matters of world-wide interest. The Annual, however, is not exclusively nor even mainly political. The religious world is liberally catered for. Art, Music, the Drama, Science, Motoring, and Sports all have their places. Special articles are devoted to Engineering Schemes and Aeronautics, the latter being illustrated with sketches of typical aeroplanes and dirigibles.

PERCY PIERCE, FLIER. A Model of a Monoplane With a Special Propeller, Rear Drive, and Landing Gear. Working Drawings and Text. New York: Spon & Chamberlain. Price, 15 cents.

THE THERAPEUTIC ACTION OF LIGHT. By Gorydon Eugene Rogers, M.D. Published by the Author. 323 pp.; 9 illustrations.

INQUIRY COLUMN

Inquiry No. 9217.—Wanted, the names and addresses of manufacturers of machinery for shelling almonds and peanuts.

Inquiry No. 9218.—Wanted, the names and addresses of manufacturers of outfits for salting almonds and peanuts.

Inquiry No. 9223.—Wanted, to buy machinery for making sugar of milk.

Inquiry No. 9224.—Wanted, to buy a motor driven floor scrubbing machine.

Inquiry No. 9225.—Wanted, a concern able to grind and polish hammers.

Inquiry No. 9226.—Wanted, to buy a machine for making flat-sided popcorn cakes.

Inquiry No. 9227.—Wanted, a power-driven saw for cutting down pine trees twenty inches in diameter.

Inquiry No. 9228.—Wanted, to buy fabric tufting machines.

Inquiry No. 9229.—Wanted, addresses of manufacturers of an alloy called Duraluminum.

Inquiry No. 9230.—Wanted, to buy a plant for the manufacture of alcohol and sawdust

Inquiry No. 9231.—Wanted, addresses of owners of water falls having a four-foot fall and upwards.

Inquiry No. 9232.—Wanted, addresses of manufacturers of engines that can be run with crude oil.

Inquiry No. 9233. Wanted, a roller or other device for skinning a beef in rapid, economical manner.

Inquiry No 9234. Wanted a small specialty of universal salability to sell from $8 to $10. Proper articles can be financed.

Inquiry No. 9235.—Wanted, names and addresses of manufacturers of machinery and appliances for making celluloid.

Inquiry No. 9236.—Wanted, the name and address of the firm making the New England Filling Machine.

Inquiry No. 9237.—Wanted, information relative to the Parmelee Automatic Aerated Water Still and Sterilizer.

Curtiss's Single Hydroplane Float for Aeroplanes

(Continued from page 196.)

a single and entirely different pontoon from those with which he made his first successful water experiments the preceding week.

It was the first time Mr. Curtiss tried the new pontoon. In fact, the paint was not dry on it when his assistants, including three army and one navy officer detailed to study aeronautics under him at the San Diego aviation school, launched the apparatus for the initial test.

After making a run of about a half mile to test the balancing quality of his machine on the water's surface, and when he had attained a speed of approximately forty miles an hour, Curtiss ascended easily from the water to a height of 100 feet. He remained aloft two minutes and ten seconds, describing a complete circle about three-quarters of a mile in diameter, and alighted on the water at the starting point without the semblance of a splash. He glided to within a few feet of the water with his motor at half speed, and then, opening the throttle, he flew about 100 yards before settling to the surface of the bay.

The new pontoon is a simple, compact affair. Instead of two floats, a water shield, and a small hydroplane with which the first successful experiments were made, the apparatus consists of a single pontoon substantially attached to the under supports of the ordinary type of Curtiss biplane. It resembles a flat-bottomed boat covered with canvas to make it waterproof. It is twelve feet long, two feet wide and twelve inches deep. At a distance of three feet from the front end the bottom curves upward, forming a sharp bow the full width of the float and on a level with its top. The same distance from the rear end the top bends downward, both ends being so near the same proportions that either could be used as the bow of the pontoon.

The pontoon is fixed beneath the planes in such a manner that the weight of the aeroplane with the aviator in his seat is carried slightly to the rear of the center of the float, giving the bow an upward tilt which materially assists the craft in rising from and alighting upon the water. The new pontoon weighs fifty pounds, or less than half as much as the apparatus with which the former flights were made.

A stick four feet long and three inches wide, to which is attached an inflated rubber tube, is fixed beneath the extreme end of each lower plane, the purpose being to support it from contact with the water in turning the machine at full speed before ascending.

After the experiment Mr. Curtiss stated that he had solved the problem of flying from and alighting upon the water to his entire satisfaction, and with the exception of making some provision for baling water from the pontoon in case of leakage, the apparatus will remain the same as the present model, so far as the hydro-aeroplanes now in use are concerned.

Labor Saving by Automobile Power

(Continued from page 197.)

companies have found other uses for the auxiliary power carried by their motor vehicles. In setting poles, pulling wires on pole lines and pulling cables in subway ducts, time is saved and about one-quarter the number of helpers are required as compared with the old methods employing the main strength of human labor. Winch trucks are also used by safe builders and movers, for raising safes to the upper floors of office buildings.

Another application minimizing idle time during the working day is in loading and unloading by automobile power. The commercial motor vehicle is expensive in first cost, and requires, in order to realize its superior capacity and efficiency, to be utilized with minimum delay, the economy and success of the vehicle depending on the extent to which

it can be kept in motion carrying a paying load. A 3-ton gasoline truck employed by a lumber company to make its deliveries, consists of the truck proper with two removable bodies and two tending yard wagons. The loading work is performed by means of the removable body, the chassis being equipped with a special framework and with a pair of shafts running the length of the vehicle on each side. Loading and unloading of lumber up to 41 feet in length is accomplished by means of a pair of drums on each of the shafts with a winch on one end of the same and ropes passing over rollers; saving from 45 to 90 minutes for each load and enabling the truck to get in and out of the yard very quickly, in its 12 miles-per-hour delivery service. In the operation of this scheme, requiring one man only, one of the bodies is always being loaded while the other is in transit on the truck, and the latter is thus kept busy most of the time during the working day.

Street sweeping and sprinkling automobile vehicles are being introduced to replace the ordinary cumbersome horse-drawn vehicles. One motor sweeper, claimed to effect a saving of 25 per cent, has wide steel tires and a 12-horse-power two-cylinder engine, giving enough power to sweep uphill on any ordinary grade. The speed of this machine is 4¼ miles per hour, as compared with 2 to 2½ miles per hour with the best horse-sweeper. It is operated by one man, and sprinkles a little water on the pavement ahead to lay the dust and then sweeps with a rotary brush and picks up the sweepings, leaving a space only a few inches wide at the curb-side to be cleaned up by the hand method. In the general hauling incident to farm work a three-ton tractor of American make can carry a good-sized load on its own bed and haul ordinary farm wagons hitched on behind at the same time. Plowing is also done quickly and cheaply, and more easily at the right time (a highly important matter in farm work) with a machine operating three 14-inch plows, which can cover eight to ten acres per day on two gallons of gasoline per acre. The mechanical plow is always ready for work, and makes the farmer independent of "soft" or galled teams of horses. Fitted with extension wheel-rims, the machine can be driven over plowed ground, pulling harrows, etc., and doing a surprising amount of work per day. The rim extensions are fitted with pins which come into action automatically and which prevents slipping when the wheel strikes soft ground. The engine is of 36 horse-power, giving a speed of 4 to 15 miles per hour, and the wheel base is 140 inches.

The automobile serves a unique purpose in the quick transportation of labor on emergency jobs. The fire departments of several cities employ a roomy gasoline car to hurry firemen from one point in the city to another in order to reinforce any district needing assistance. The car is equipped with fire extinguishers and other light apparatus, and has a seat for the Chief, in front beside the driver, and two lengthwise benches behind for the men. The same idea is carried out by a Lynn, Mass., gas and electric company in a repair and general line service wagon employed to convey a gang of ten or twelve linemen from point to point and also fitted to haul poles on trailers hitched on behind. Another time-saving proposition is in trimming arc lamps in cities. Much of the time formerly consumed by lamp trimmers in covering their routes on foot, and either climbing the posts (which were stepped for the purpose) or lowering the lamps to the street by a tackle, is saved by the tower-wagon shown herewith. In an arrangement used on some routes in New York city, two men constitute the crew of this vehicle: The driver, who jumps out at each lamp-post to open the switch at the base of the post with a key, and the trimmer, who remains on the swivelled, overhanging top of the tower.

Fuel from Nile Sudd

By Our London Correspondent

AS is well known, one of the great difficulties relative to navigation on the Nile, is the obstruction offered by large masses of dense waterweed or grass, generally known as sudd. For a distance of 300 miles the river runs through a very swampy country, estimated to cover 35,000 square miles and known as the Sudd District. A great drawback to this territory is the complete absence of fuel of any description, there being no timber, while coal has to be imported, and the price of these two commodities averages about $13 per ton. The existence of this weed offered a severe obstruction to the development of the Soudan, since at this point the Nile could not be safely navigated, owing to dense clumps of the grass, detached by floods, gales, and so forth, drifting into and blocking the main channel. The task of clearing the river and keeping the waterway open is thus expensive and difficult.

A German diplomatist, however, conceived the idea that this grass must possess a certain calorific value, and suggested that it might be harvested and converted into a fuel very cheaply, so as to meet the local deficiencies in this direction. Lord Cromer and Sir Reginald Wingate were approached, and the assistance of the Soudanese government being secured, a small commission was dispatched to the Sudd District to study the feasibility of the idea on the spot. Large quantities of the grass were secured and dispatched to Merseburg, in Germany, where experiments were at once undertaken to determine how its conversion into fuel might be effected, together with the determination of the calorific value.

As a result, a very simple and inexpensive process has been evolved. The sudd is first dried and then submitted to treatment in a disintegrator, which reduces it almost to the form of powder. The mass is then briquetted. Recently Lord Cromer, Sir Reginald Wingate and a representative of the German and Soudanese governments witnessed a demonstration of the process. The manufacture into briquettes occupies only a few minutes, and in the calorific tests that were carried out, it was ascertained that the heating value of the disintegrated sudd is about 60 per cent that of coal, while the density of the briquette is 80 per cent of coal. The cost of manufacture was found to be so satisfactory as to enable the product to be manufactured on the spot in Egypt, to be sold for about 50 per cent of the local price of imported coal.

The Soudanese have now granted a concession for the installation of a manufacturing plant in the Soudan, and are assisting the development in a tangible financial manner. The success of the experiments has provided economical and efficient means of disposing of the river obstruction, and will solve the local fuel problem to a unique degree. Owing to the expanse of the Sudd District, and the immediate availability of unlimited supplies of the raw material, it is anticipated that an important industry in the Soudan may be developed.

THE total of live stock of all kinds which used the national forest ranges during the year under pay permits fell off 2.75 per cent in comparison with the previous year. This is the first year since regulated grazing began that there has not been an increase. The cause of the drop is to be found in the reduction of the available range through eliminations of land found to be better suited to other uses than to forest purposes.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12388) **A. R. M. asks: Will you ad-**vise the amount of draft necessary for the ordinary locomotive? I want to get at the proper amount of draft in case the exhaust steam which is now used through the stack for this purpose is taken away for other purposes. A. Stationary boilers burn 10 to 20 pounds of coal per square foot of grate per hour, with a draft pressure equal to ¼ to ½ inch of water. Locomotives burn 100 to 200 or even more pounds of coal per square foot of grate per hour under a draft sometimes as great as 5 to 7 inches of water, induced by the exhaust blast pipe. The air required for theoretically perfect combustion is 12 to 14 pounds per pound of coal, and for practical results about twice as much. The locomotive therefore requires 2,400 to 5,600 pounds of air per hour, or 500 to 1,100 cubic feet of air per square foot of grate per minute, or with 25 feet of grate surface—almost the minimum in use—a total of 62,500 to 94,000 cubic feet of air per minute. Some engines have grates 60 square feet, and even more, so that it would seem that the largest engines may require as much as 200,000 cubic feet of air per minute at times.

(12389) **R. L. M. says: Will you** kindly give an approved type of label for bottles for a small chemical laboratory? A. If you do not buy reagent bottles with the names, etc., blown or etched, you can use paper labels

SODIC CARBONATE
$Na_2CO_3 10H_2O$

of convenient size. You can purchase them ready printed at small expense, giving the symbol and name. The annexed cut shows in reduced facsimile a simple type of label.

(12390) **B. J. K. asks how to brown** iron and steel. A. 1. Dissolve in 4 parts of water 2 parts of crystallized iron chloride, 2 parts of antimony chloride and 1 part of gallic acid, and apply the solution with a sponge or cloth to the article, and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water, and dry, and finally rub the articles over with boiled linseed oil. The metal thus receives a brown tint, and resists moisture. The antimony chloride should be as little acid as possible. 2. A process having this end in view has been recently patented in Germany by Mr. A. De Meritens. The goods to be browned form the anode of the bath, which consists of ordinary or distilled water. The cathode is formed by the vessel which contains the water, if it is made of iron; otherwise, a plate of iron, copper or carbon is placed in the bath. The water is kept at from 160 to 180 deg. F., and the tension of the current must be sufficiently great to decompose the water. The oxygen which thus is given off at the anode forms in an hour or two a layer of the black oxide of iron (a combination of ferrous and ferric oxide), which is said to polish up very well. Steel is said to give the best results; in the case of cast and wrought iron, the oxide of iron formed separates as a powder, and it is necessary to use distilled water in order to obtain a layer which will adhere to the goods.—From the new "Scientific American Cyclopedia of Formulas." Price, $5.

(12391) **C. L. asks how to soften steel.** A. 1. Place a quantity of newly burnt lime in a damp place, where it will fall in the form of flour; put it in an iron box. Heat the articles to dull red; clean off all scale, and put in lime, and completely cover with lime; cover box over with iron lid and leave until cold. The more lime and larger the box the better. Keep airtight if possible. 2. One tablespoonful each of hydrochloric acid and saltpeter to 1 gallon of water. Heat the steel and cool in it; then heat to soften by letting cool. Cast steel thus treated will weld with sand.

(12392) **A. A. C. asks: Assuming the** friction to be reduced to a minimum, what would be the volume of free air, and its velocity leaving a nozzle ⅜ inch in diameter, at the following pressures—20, 40, and 80 pounds? A. From Kent's "Mechanical Engineers' Pocket-Book" we take Fliegner's formula for flow of air under pressure through an orifice: $G\ 0.53\ F \frac{P}{T_1}$, wherein G is the flow of air in pounds per second, F area of orifice in square inches, P absolute pressure in reservoir in pounds per square inch, T_1 absolute temperature (Fahr.) of air in reservoir. This formula, by the way, is only applicable to cases where the pressure behind the orifice is more than twice the pressure into which the air flows. Applying the formula to your cases, assuming 59 deg. temperature, or an absolute temperature of 520 deg. F., and F being 0.11 square inch for a ⅜-inch opening; for the three values of P, 35, 55, and 95 pounds above vacuum, the formula becomes:

$$G_1 = 0.53 \times 0.11 \times \frac{35}{520} = 0.00255 \times 35 = 0.08925 \text{ pound.}$$

$$G_2 = 0.00255 \times 55 = 0.14025 \text{ pound.}$$

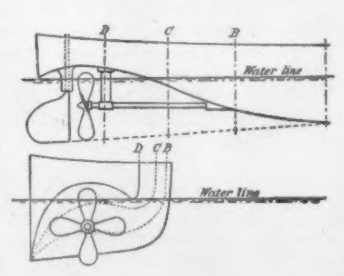
$$G_3 = 0.00255 \times 95 = 0.2423 \text{ pound.}$$

The three weights, divided by the weight of one cubic foot free air at 59 deg. temperature, 0.076, give 1.17, 1.84, and 3.19 cubic feet per second, respectively. As the area of the ⅜-inch orifice, 0.11 square inch, is 0.00076 square foot, dividing this area into the three volumes gives 1,540, 2,420, 4,190 feet per second velocity for the three pressures, respectively.

(12393) **M. K. W. asks how to platinize** silver. A. Place some platinum in a small quantity of aqua regia or nitro-muriatic acid, and keep it in a warm place a few days; it will dissolve. As soon as it has dissolved, evaporate the liquid at a gentle heat until it is as thick as honey, so as to get rid of the excess of the nitric and muriatic acids. Add a little water, and it is ready for use. A dozen drops of this solution goes a long way in platinizing silver. The operation is performed in a small glass or beaker, covered with a watch-glass to keep in the fumes, and placed in a little sand in a saucer, to equalize the heat.

(12394) **W. M. asks' How many cells** would it take to make a 4-inch spark? A. A battery of six cells, giving 10 volts and 8 amperes, should work a coil which can give a 4-inch spark. Our SUPPLEMENT No. 1527, price ten cents, gives the plans for a 4-inch coil.

('12395) **N. C. H. Writes: When it is** desired, in shallow water, to get more power from a single-screw propeller boat, it is customary to equip it with twin screws. My objections to them are: Greater first cost and greater expense of two independent sets of machinery; greater liability to damage by contact with logs, snags, etc., owing to the screws being located near the outer edges of the hull. On ocean-going vessels propelled by turbines, two screws have been used on one shaft, and similar arrangements of screws, or tandem propellers, are used, or their use is advocated, on aeroplanes. Now I want to operate a propeller boat in a river that limits the draft to about 36 inches, and the propeller to about 30 inches diameter. As one wheel alone of this size would be too small to do the work expected of the boat, which is principally towing, I propose to use tandem instead of twin screws; and when used in this manner, I would like to know which would give the best results, i. e., two-bladed, three-bladed, or four-bladed 30-inch wheels. A. Your objection to twin screws on account of increased maintenance charges is not of great moment. They can be protected fully from damage by giving the boat sufficient



beam. The early turbine boats used two or three propellers on the same shaft, but the idea was abandoned for a single propeller of small diameter. The diameter of propellers for turbines is limited by the high rotative speed, which produces "cavitation" at the tips, and consequent loss of efficiency. The usual propeller blade is of elliptical shape, while the turbine propeller blade is broad and rounded. For your purposes, we would advise building a boat with what is known as the "tunnel stern." In this the bottom rises and forms a tunnel over the propeller, the top of which is above the normal water line, and when under way, the air goes out and the water rises above the outside level. The propeller can thus be of greater diameter. These have been used in towing on the Ohio River and were described in a paper in the 1909 Transactions of the Society of Naval Architecture, entitled "River Steamers." See also Barnaby's "Marine Propellers." The tunnel may be used with single screws as well.

Electricity

Electricity in China.—Our Consul in Hong Kong reports that China is ripe for the introduction of electrical machinery. However, an educational campaign is necessary. He suggests the importance of sending engineers to China who can advise upon the subject of installing light and power in Chinese cities. There are very few Chinese engineers who can do such work, and the matter of having a special representative in China would be of untold value to the Chinaman, as well as to the manufacturer of electrical machinery.

Change in the Value of the Volt.—Since the first of the year the National Bureau of Standards has adopted a new value for the standard volt in this country to correspond with that in England, France and Germany. The change, while numerically very slight, will be felt in the incandescent lamp industries. The change is based on the value of the Weston cell at 20 deg. C. Heretofore we have rated the cell at 1.091 volts; now the rating is 1.0183 volts. Our volt is hence made eight ten-thousandths larger than heretofore.

Electrical Exports for 1910.—The Bureau of Statistics has published a report on the electrical exports for last year, which shows that the total came close to that of 1907. Had it not been for the small figures for February and January, a new record would have been made. In 1907 the total exports were $17,460,775. Last year they amounted to $17,001,126. While the exports of electrical appliances exceeded the figures for 1907 by about two million, there was a marked drop in the exports of electrical machinery, bringing the total of the year nearly half a million below the record.

Sending Telegrams by Telephone.—At the time when the Bell Telephone Company combined with the Western Union Telegraph Company it was decided to transmit telegraph messages by telephone, whenever possible, in order to provide quicker service and reduce the cost of using messengers. This plan has not proved as successful as was at first anticipated, owing to the fact that important telegrams were sometimes delivered to the wrong persons. For this reason, it is reported, the Western Union Company has decided to revert to the old system of transmission by messenger.

The Output of Tungsten in 1909.—According to figures recently published by the Geological Survey, the total production of tungsten in 1909 was 5,289 short tons of ore, containing 60 per cent of tungsten trioxide. It is believed that the percentage is placed rather low, and that the ore contains more than 60 per cent of tungsten. Of this quantity, 1,619 tons were produced in the United States, 1,200 tons in Australia, 900 tons in Argentina, 609 in Portugal, 421 in the United Kingdom, 168 in Bolivia, and 106 in Germany. Tungsten has become such a strong rival of tantalum in the incandescent lamp industry that the demand for tantalum is decreasing materially.

Diversion of Water from Niagara Falls.—The Burton Act, which limits the amount of water which may be diverted from Niagara Falls to 15,600 cubic feet per second, expires on June 1st. Thereafter the waters of Niagara will be in the hands of the Secretary of War. While the Burton limitation will be removed, there is still a treaty limitation with Great Britain, permitting only 20,000 cubic feet per second of water to be diverted by the United States, and an equal amount by Canada. There is now a measure before the House of Representatives which aims to allow the United States to divert permanently the entire 20,000 cubic feet per second, and also aims to place no limit upon the amount of electric power that may be transmitted into this country from Canada. Such a limit was imposed by the Burton bill.

Engineering

To Exploit the Diesel Motor in America.—A recent editorial in our columns expressing regret that the excellent Diesel motor is not receiving commercial recognition in this country has brought to this office a letter stating that, two or three weeks previous to our comment, a company of leading engineers and financiers had been formed for manufacturing and exploiting this engine.

Mesopotamia to Bloom Again.—Sir William Willcox, who has been surveying the ancient country lying between the Tigris and the Euphrates, has obtained a contract for the construction of the first dam in the irrigation works which were designed by Sir William Willcox for restoring Mesopotamia to its ancient fruitfulness. This arid waste, now infected by swamps, contains traces of ancient irrigation canals, and its one-time fertility is a matter of well-substantiated history.

Panama Canal Fair at San Francisco.—We note that, by a very large majority, the House has chosen San Francisco as the exposition city to celebrate the completion of the Panama Canal in 1915. Although we consider that these great fairs have been too frequent in the past few years, and have been dominated too much by the spirit of commercialism, we congratulate San Francisco on its selection, and express the hope that the authorities will make the event what it should be—a great educational influence.

Progress of Work at Panama.—The report of the progress of the work at Panama during December shows that during the month there was completed 1,-488,880 cubic yards of dry excavation and about one million cubic yards of excavation in the wet, making, with excavation for plant, a total for the month of 2,603,-206 cubic yards. As compared with the preceding month, there was an increase of 5,060 cubic yards in the amount of concrete laid, the daily average for the twenty-six working days being 2,085 cubic yards.

Proposed Black Sea and Baltic Canal.—There is a movement on foot in Russia to build a canal with a minimum depth of 14 feet between the Black Sea and the Baltic. The total length from Riga to Kherson is 1,336 miles, and on this division for 322 miles the canal will follow the bed of the west Dwina. This section is to be followed by 63 miles of entirely new canal, ending in the river Dnieper. The remaining portion of the canal, for a distance of 1,010 miles, would lie in the bed of the Dnieper. The estimated cost is $150,000,000.

Serious Interurban Car Accidents.—The increase in the size and speed of interurban electric cars has reached a point where there is a demand for a thorough revision and improvement of the methods of operation, and particularly of the system of car dispatching and signaling. The necessity for this is to be found in several shocking collisions which have recently occurred, in which the number of deaths and injuries approached those of the worst steam railroad collisions. Wherever it is possible, interurban roads should be double-tracked, and the latest block signal system, or some modification of it, introduced.

To Maintain London as the Leading Port.—In the hope of maintaining London as the leading port of the world, the port authorities propose to spend over seventy million dollars in improving the dock and harbor facilities of the Thames below London. The river channel from Tilbury to London Bridge is to be widened to one thousand feet and deepened to thirty feet, and at Tilbury three new docks of 65, 126 and 138 acres, respectively, are to be constructed, which will be "capable of dealing with any possible growth in the size of vessels for many years to come." The improvements are expected to extend over a period of twenty years.

Aeronautics

The Technical Terms of Aeronautics.—The Technical Words Committee of the Aeronautical Society of Great Britain recently issued a standard list of aeronautical terminology Among others in the list appear the following:

Helicopter—A flying machine supported by one or more propellers, rotating on vertical or apparently vertical shafts.

Ornithopter—A "flapping wing" machine.

Many other technical words of aeronautics are listed and properly defined.

An Attempt to Fly Across the Hudson River.—After an unsuccessful attempt to fly from the Guttenberg race track in New Jersey across the Hudson River to New York some time ago, which ended by a collision with a house, Frank Morok, the Belgian aviator, made a second attempt on the 16th instant. Soon after he was above the river, at a height of 600 feet, his motor stopped and he glided quickly to the surface of the river. He was picked up by a launch, uninjured, but his Schneider biplane was a complete wreck.

A New British Biplane.—Important tests were made on January 14th by the British Army aerial authorities of a new type of biplane. The machine is the invention of Mr. G. de Haviland, a member of the Army Balloon Works' staff. It is about the size of the Curtiss biplane, having planes about 30 × 5 feet spread, spaced 5 feet apart. The single vertical rudder is foot-controlled, but the front and rear horizontal rudders and the ailerons are all worked by hand. The engine is of an entirely new pattern, and the propeller is mounted on its crankshaft. The test flights, of which three lasted over 20 minutes, and the final one 70, showed a speed of between 35 and 40 miles per hour. Mr. de Haviland also made three short flights with a passenger, one of whom weighed 204 pounds.

Aeroplanes and Dirigibles in the French Army.—In his official report made the first of the year, M. Clemental states that France has 32 aeroplanes in use in the army and 34 military aviators to fly them. The biplanes and monoplanes consist of the following machines: 2 Breguet, 4 Sommer, 4 Maurice Farman, 11 Henry Farman, 5 Wright, 2 Antoinette, and 4 Blériot. No less than 8 additional Blériot monoplanes underwent tests and were taken over during three days the middle of last month, so that France now has 40 military aeroplanes. In time of war she could muster 14 dirigibles besides. The main aeronautic shop and laboratory of the army is at Chalais Meudon, near Paris, while at Vincennes there is an aerodrome where aeroplanes are tested and experiments in flying conducted.. A number of smaller establishments are located at other points, as well as schools for the training of pilots.

Wireless Experiments with Aeroplanes in America.—During the course of the aviation meet last month at San Francisco, Lieut. Paul W. Beck of the Signal Corps went aloft in a Wright biplane piloted by Parmalee and transmitted wireless messages for a considerable distance while at a height of 1,000 feet. These messages were received at the Mare Island navy yard, 40 miles away, as well as at the Yerba Buena Island training school in the bay. In Lieut. Beck's experiment a 100-foot length of copper wire was trailed behind the aeroplane; but in some experiments recently made in New York by Mr. Horton, it was found possible to utilize the guy wires of the aeroplane instead. In France last month wireless messages were transmitted 15 miles from an aeroplane successfully, while in England, during a trip of the military airship "Beta" on January 28th, from Farnborough to Portsmouth and return, the officers on board were able to transmit messages 30 miles to headquarters.

Science

New Storm Signals in France.—France has been the first country to begin the use of the new international storm signals, described in the SCIENTIFIC AMERICAN of January 21st. The new system went into effect at French seaports on January 15th.

Molecular Dispersion.—Even the most solid metals lose some of their molecules by dispersion from the surface, but some curious peculiarities are observed in the process of molecular dispersion. For instance, when a piece of gold is pressed against a piece of lead, some of the molecules of the former disperse into the lead. The process is, of course, extremely slow, and years are required before its effects become evident. But slow as it is, the dispersion of the molecules of gold into a mass of lead takes place faster than into either air or water. The surface molecules of water disperse readily into air, but refuse to enter oil. The molecules of salt disperse quickly in water, but refuse to enter air, or most solids, in appreciable quantities.

Initiation Among the Eskimos.—A device for protecting the lungs and throat from the injurious effects of foul air was found in use among a tribe of Alaskan Eskimos by Capt. Jacobsen, in the course of his expedition of 1881-1883. This Eskimo respirator is a little basket woven of twisted strands of fine grass. It is placed with its hollow side against the mouth, and a wooden peg, which rises from the center of the basket, is held between the teeth. The respirator affords protection against the dense smoke which is evolved in preparing and taking a vapor bath. For this purpose water is evaporated over a big fire in a very low hut, which is tightly closed to keep in the heat. In this stifling atmosphere the employment of a respirator is absolutely necessary.

Solid Particles in Human Breath.—It has hitherto been assumed by physiologists and hygienists that the exhalations from the lungs were composed entirely of oxygen, nitrogen, carbon dioxide, water vapor and other gases and vapors, without any admixture of solid matter. According to a recent note in *Cosmos*, Dr. Courtada has examined with the ultra microscope the moisture of the breath, condensed without contamination with atmospheric air, and has found therein a multitude of solid particles, of various shapes and sizes, some motionless, others moving, and presenting the appearance of cocci (globular bacteria) and bacilli (rod-like bacteria). Epithelial cells were also found. A few drops of this moisture, evaporated to dryness on a glass plate, left a dusty deposit nearly as dense as the deposit left by an equal quantity of potable water. No bacterial culture could be obtained, however, although four different culture mediums were tried.

A Service for Agricultural Meteorology.—It is reported that the French government is about to organize a special service of agricultural meteorology, under the direction of the Ministry of Agriculture, distinct from the general meteorological service, which belongs to the Ministry of Public Instruction. Exactly the same thing has recently occurred in Russia, where the Ministry of Agriculture now has a meteorological service of its own, distinct from the large and well-organized service pertaining to the Central Physical Observatory; while something analogous exists in Germany, where a few years ago the Prussian Ministry of Agriculture organized a new public weather service, which is independent of the old meteorological institutes of the German States. There seems to be a well-defined movement in the direction of giving agricultural meteorology an independent status. This plan undoubtedly entails a great deal of duplication of work, and its *raison d'être* is hardly apparent.